Artha Vijnana

(New Series)

Volume III, Nos. (1-2), 2004

Contents

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(NEW SERIES)

THE JOURNAL OF THE DEPARTMENT OF ECONOMICS, UNIVERSITY OF CALCUTTA

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Published by Soumyen Sikdar, Chairman, Editorial Board of ARTHANITI, on behalf of the Department of Economics, Calcutta University.

Printed at: Calcutta University Press

Computer Type Setting & Designing : Suchhanda Chaudhury

Front Page Design : Suchhanda Chaudhury

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Arthaniti 3 (1-2), 1-16 / 2004

Infrastructure and Development Interlinkage in West Bengal: A VAR Analysis[a]

Rajarshi Majumder* and Dipa Mukherjee**

Abstract

Theoretical propositions proclaim that the association between Infrastructure Availability and Development of a region is quite strong and runs from the former to the latter. Empirical studies are however, inconclusive. While few researchers have concluded that the impact of infrastructure on development levels, though positive, is not significant, equally large numbers of studies claim that infrastructure explains a substantial part of development levels. In this paper the association between infrastructural availability and development for the West Bengal economy is explored using a multidimensional approach and a time series study. It is observed that both developmental and infrastructural indices have shown a continuously rising trend during 1971-2001 The causation seems to be stronger from infrastructure to development. The long run relationships suggest strong positive impact of infrastructural availability on development levels Different facets of infrastructure seem to have different impacts on different dimensions of development. A segmented policy aiming at specific sectors need to be adopted, with the greatest importance being attached to those infrastructural indicators that have highest total impact and strongest 'linkages' across sectors. Only this can sustain the development 'push' generated in West Bengal. Otherwise, the superstructure will have only a weak base and will come crashing down any day.

JEL Classification : C32, H54, O11, R11, R53, R58.

Keywords : Infrastructure, west bengal, unit root test, var technique.

1. Introduction

The association between Infrastructure Availability and Development of a region is a widely discussed and accepted issue. There are a large number of theoretical propositions that conclude that the association is quite strong and runs from the former to the latter [e.g. Hirschman (1958), Rostow (1960), Nurkse (1953), Rosenstein-Rodan (1943) and Hansen (1965)]. Substantial volumes of empirical studies have tried to measure the magnitude of this association, and therein the debate starts. Few researchers have concluded that the impact of infrastructure (or Public Goods) on development levels, though positive, is not significant [e.g. Hulten (1984), Evans (1994), Holtz-

a We are greateful to Prof. A. L. Nagar for directing our attention towards the vast world of Time Series Econometrics. We are thankful to participants and discussants at the Third Annual Conference on Models and Methods in Economics at ERU, ISI, Kolkata held on 15 - 17 January, 2004, and an anonymous referee for their commants on an earlier draft of the paper. However, usual disclaimers applies.

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Eakin (1994), Crihfield (1995), Conrad (1997)]. On the other side, there are also equally large number of studies that claim that infrastructure explains a substantial part of development levels. This second argument seems to have gained wind in the last decade, especially after the publication of the World Bank World Development Report 1994 focusing on Infrastructure. It is now felt that adequate and quality infrastructure is a prerequisite of growth and development. Most of the empirical studies have however concentrated on Cross-sectional studies, wherein regional variation in development and growth were sought to be explained by regional diversity in infrastructural levels. But cross-sectional regions are widely different in socio-economic and technical characteristics. This approach thus includes impact of secular differences in the characteristics of the regions within the impact of infrastructure and tends to overestimate the latter. Secondly, most of these studies use a unidimensional approach with development level being captured by Income or Consumption levels. We try to eliminate these two drawbacks while examining the issue. In this paper we try to explore the association between infrastructural availability and development using a multidimensional approach and for the economy of West Bengal. Thus, a time series study analysing the interaction between infrastructural availability and development levels in West Bengal for the period 1971-2001 is attempted at.

The first section briefly discusses the methodologies involved. The second section narrates the trends in different infrastructural and developmental variables. The third one explores the relationship between them and the fourth section summarises the results and discusses the policy implications of the findings

2. Methodology

Construction of Composite Indices

The multidimensional facets of development is sought to be captured by three broad components - Agricultural development (henceforth Agdev), Industrial development (Inddev) and Human development (Hudev). Similarly, Infrastructural availability is composed of Rural & Agro-specific (Aginf), Transport (Trinf), Power (Powinf), Financial (Fininf), and Social Infrastructure (Socinf). Each of these indicators is composed of more than one indicator and is constructed using the Modified Principal Component Analysis method from them.[1]

Agdev is prepared from Land Productivity [Value Added (VA) per hectare Gross Cropped Area (GCA)], Labour Productivity (VA per agricultural labourer), Extent of Commercialisation (% of GCA under commercial crops), and Cropping Intensity (GCA/ Net Sown Area). Similarly, Inddev is constructed from Registered Factories per 1000 sq. km. area, % of Net State Domestic Product (NSDP) from manufacturing sector,

[1] The modified PCA method, MODPCA, has been evolved by Amitabh Kundu and Moonis Raza. Refer to Kundu and Raza (1982).

VA per labour in registered factories, Per capita NSDP from secondary sector, and Factory workers as % of total population. Hudev is prepared from Infant Mortality Rate, Crude Death Rate, Crude Birth Rate (all suitably transformed to reflect positive aspects), Per Capita NSDP (PCNSDP) and Enrolment Ratio in Primary schools. In the second stage, these indices are combined again to yield a single composite index of development (Devt). The standard measure of development – PCNSDP – is also considered separately.

Constituent variables of Aginf are Irrigation Intensity (Net Irrigated Area/NSA), Fertiliser consumption per hectare GCA, Power consumed for agricultural purpose, and Bank Credit to agriculture per hectare GCA. Trinf is composed of Road and Railway length per 1000 sq. km. area, and % of roads surfaced. Powinf consists of % of villages electrified, per capita power generation, and Plant Load Factor (generation as % of generating capacity). Fininf is composed of Bank Branches per 1000 sq. km. Area and per lakh population, Bank credit to Industries per industrial worker, and per capita State Financial Corporation credit off-take. Socinf consists of Hospitals and dispensaries, primary schools, higher educational institutions (all per 1000 sq. km area), Medical personnel as % of population and State per capita expenditure on primary education.

At the second stage, Aginf, Trinf, and Powinf are combined to yield index of Physical infrastructure (Phyinf). At the third stage, all five first order indices of infrastructure are combined to form a single composite index of infrastructural development (Infra). This method thus provides us 5 Developmental indicators (including PCNSDP) and 7 Infrastructural indicators (Phyinf, Infra, and five sectoral ones) for West Bengal for each of the 30 years from 1971 to 2001. The data have been collected from various sources mentioned in the endnotes.

It is observed that all constituent variables have positive factor loadings in the first principal component score. The first principal component is observed to explain more than 80 % of the total variability in the constituent variables in all the cases They are thus reasonably good representatives of the aspects we are looking into. Subsequent analysis is based on these indicators.

Also, this time-series study gives us an opportunity to test whether any structural break in the two series occurred at the initiation of three important changes in policy-regime in West Bengal - the ascension of Left Front to power, and the liberalisation of the economy both at 1984 and at 1991. For these, 1978, 1984 and 1991 are taken as the watershed years and the Dummy Variable technique is used to test for structural breaks at these points of time in the relationship between infrastructural availability and development in West Bengal.

Time Series Study of the Indices

The study of time series requires certain caution while using simple correlation and regression in analysing association and causation between variables. Variables over time, more often than not, have time trends making them non-stationary, and the resultant correlation and regression become spurious. To avoid this, various techniques have evolved over the years. One of them is using the Unit Root Test, the Autocorrelation Function and the Partial Autocorrelation Function to determine the Order of Integration of the different series and then using Engel-Granger (Engel and Granger, 1987) methodology for checking whether the series are co-integrated or not.[2] If they are, then OLS can be used. Other methods follow the Box-Jenkins methodology of model selection, testing for causality, identifying dependent and independent variables, and specifying the functional form. If no such clear demarcation is possible, the Vector Auto Regression (VAR) technique is used, which is essentially a Simultaneous system approach We follow the above path in sequence to explore the relationship between infrastructure and development in West Bengal over the period 1971-2001.

3. Trends in Infrastructure and Development

Empirical Trends

The general trends of the indices show that all of them have experienced a sustained rise over the study period 1971-2001. The magnitude and rate of rise in the indices has also been substantial – by 320% for Aginf, 347% for Fininf, and 196% for Powinf. For Trinf, the rise has been by 58%, and for Socinf it is only 18%. This has resulted in an 80% rise in Phyinf and 90% rise in the composite infrastructural score - Infra. The rise in developmental indices are also quite sizeable; 32% for Inddev, 68% for Hudev, and 113% for Agdev. As a result, the composite developmental score Devt has increased by 68% during these 30 years. This period have also witnessed a 118% rise in PCNSDP. However, the rising trend has not been smooth over the years. There seems to be some fluctuations in all the developmental indices during the period 1977-1982, reflecting, may be, the socio-political turmoil of those times. In addition, the increasing trend is well defined till mid 1990s only. In the late 1990s, the indices again show fluctuating trends, especially the indices of Industrial development, Transport infrastructure, and Financial Infrastructure. Socinf on the other hand has increased till 1986, decreased continuously during 1986-95, and again increased thereafter.

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[2] The Engel-Granger tests are now replaced by more powerful Johansen Tests. For details see Johansen (1991, 1995) and Johansen and Juselius (1990).

However, we are more interested in the secular (statistical) trends, if any, in the indices and the long run relationship between the infrastructural and the developmental indices.

Statistical Trends in the Indices

To determine the trends in the indices, it has to be tested whether they are Stationary or not. The usual stationarity test, viz. the Augmented Dickey Fuller Test for Unit Root reveals that all the indices are Non-Stationary with one unit root, i.e. they are integrated of order 1. In addition, they also have secular deterministic trend, making them a Mixed Process. The only exception is Fininf, which does not have Unit root but has a trend, making it a Trend Stationary Process.

In addition, the ACF and PACF indicate that the processes also include Autoregressive Error terms of order 1 in all the indices. Only for Socinf, an AR(3) process is indicated.

We also tried to examine whether there has been any structural breaks in the trends shown by the indices during the three time-points – 1978, 1984, 1991. Presence of no such structural breaks could be detected in any of the indices.

4. Direction of Causality

Considering that the indices are non-stationary, simple OLS method of estimating the relationship between them is ruled out, at least for the time being. Also, it has to be accepted that there may be bi-directional causation between infrastructural and developmental indices. Consequently, the System method should be preferred for estimation. Each of the five developmental indices paired with each of the seven infrastructural indices yield 35 possible systems. These systems are estimated using Vector Auto Regression (VAR) technique. The length of the lags to be included in each system is determined in a trial and error method using the usual information criteria like Akaike Information Criterion (AIC), Schwartz Criterion (SC) and Likelihood Ratio (LR). Once the lengths of the lags are decided, the systems are tested for Causality using Granger causality test.

It is observed that the results indicate strong unidirectional causality in most of the systems involving Inddev, Hudev and Devt, where the causation runs from Infrastructure to Development (Table 1). However, for PCNSDP, bi-directional causality seems to operate between the infrastructural indices and PCNSDP. This is true for Powinf also, where there seems to be bi-directional causality between the developmental indices and Powinf. For the other systems, especially for those involving Agdev, no strong causality is hinted at by the Granger tests, thereby making the conclusions indecisive. This vindicates our use of System method. The solution of the VAR models however, provides further insight into the causality.

The Impulse Response Functions show that for all the systems, responses in developmental indices to shocks in infrastructural indices are much higher compared to responses of infrastructural indices to shocks in developmental indices. Moreover, the responses in the former case are found to be increasing in subsequent periods, while in the later case they are found to be decreasing with time. Variance Decomposition reveals that substantial portion of variation in developmental indices can be attributed to variance in infrastructural indices. On the contrary, the proportion of variation in infrastructure attributable to development indices is quite low. It has to be noted that these results depend crucially on which variable (developmental or infrastructural) is mentioned first in the order of model-solve in the computational programme. So the models were solved by reversing the order also (i.e. mentioning infrastructural indices first). It comes out that in such cases the patterns of the results are similar to the earlier one, though the magnitude of impulse responses or variance decomposition are much lower than before. Thus, it can be reasonably argued that though there is bi-directional causality between infrastructural and developmental indices, the causation is stronger from infrastructure to development rather than the other way round. It is development that seems to depend on infrastructural availability.

5. Long Run Relationship

Once the matter of causation is decided, we turn towards the long run relationship (LRR) between the indices. As such, the main objective of this study is to estimate the LRR between the developmental and infrastructural indices in West Bengal and deduce the implications thereof.

The VAR technique gives us an approximation of the functional relationship between the indices. However, these are unrestricted regressions and one possibility regarding regression between integrated and non-stationary series is that of Cointegration. If two series are cointegrated, then the LRR between them can be approximated by the Cointegrating Equation (CE). And if two series are cointegrated, then the vector regression has to be restricted by this LRR and has to be solved by Vector Error Correction (VEC) technique, rather than VAR.

The Johanssen Multi-equation test for Cointegration is used here. Inclusion of intercept and/or trend in the CE is decided by the usual information criteria (minimum AIC and SC, and higher Likelihood Ratio). Once the suitable model is specified, the tests for presence of CE are performed It is observed that of the 35 systems, in 17 cases presence of CE is not indicated For these systems that do not indicate presence of cointegration, the VAR results are retained. For the other 18 cases where presence of CE is indicated, the CE is taken to be the LRR between the two variables. Once presence of a CE is confirmed, we solve the vector model using VEC. The solution of VEC is not used as the LRR though. The coefficient of the CE in the VEC model would determine whether the LRR is stable or not. If the coefficient of CE in the

equation, where the LHS variable is that one which is the first one (or the normalised one) in the CE, is negative, we can say that the LRR is stable. To be more elucidating, let the CE be $x_{1t} - \alpha - \beta x_{2t}$, and the VEC be $\Delta x_{1t} = \Delta x_{2t} + \theta [x_{1t-1} - \alpha - \beta x_{2t-1}]$. Let in period (t-1), x_1 be greater (less) than $\alpha + \beta x_{2t-1}$. If now θ is positive, then in the next period Δx_1 will be relatively more (less) than Δx_2 and they will diverge further. If on the other hand, θ is negative, then Δx_1 will be relatively lower (greater) than Δx_2 and the gap between them will decrease and the LRR will be restored. And once LRR is achieved, i.e. the CE becomes valid, for the subsequent periods Δx_1 will be equal to Δx_2 and the equilibrium will continue.

It is evident from the results that of the 18 CE-s obtained, for 16 systems the CE-s are stable and provide the LRR between the developmental and infrastructural indices. Only 2 relations – that of PCNSDP with Trinf and Socinf - is observed to be unstable. This result may be due to wrong specification of the Cointegrating model. Other model specifications should be used to find out if any Stable LRR for this system is yielded. This issue has not been probed further.

The final estimated models in terms of the coefficients of infrastructural indices with developmental indices as dependent variables are reported in Table 2.

Another parameter of interest in case of the VEC models is the Speed of Adjustment or the coefficient of the Error Correction term or CE. As has been reported earlier, of the 18 VEC models, the CE yields stable relation in 17 cases. The speed of adjustment parameters for these are reported in Table 3. It is observed that the effect of any short-run discrepancy between the actual and long run equilibrium values of the variables is quite substantial and the speeds of adjustment are quite substantial in many cases.

6. Final Estimated Models

It is observed from the estimated models that the coefficients of the infrastructural indices are almost always positive (Table 2). In most of the cases they are significant also. This indicates that changes in infrastructural indices would lead to significant impact on developmental levels in the subsequent periods. Considering that many of the estimated results are long run relations, the stability of the estimated models should also be quite robust. In fact, as mentioned earlier, Dummy Variable Technique has also been used to test for structural breaks in the relationships at important historical datelines like 1978, 1984 and 1991. In none of the cases any significant structural break can be traced. Consequently, it can be reasonably argued that the model estimates depict the relationship between developmental and infrastructural indices for West Bengal.

An Extension – The Multivariate Situation

While so far we have examined the bivariate relationship between pairs of developmental and infrastructural indices, it is more realistic to presume that developmental levels depend simultaneously on all the three types of infrastructural facilities – physical, financial and social. Consequently, we now examine the multivariate situation where each of the developmental indices is taken along with the three infrastructural indices. The first VAR system with Agdev, Phyinf, Fininf, and Socinf yields best-fit model with 2 lags. The variables are observed to be co-integrated with 1 CE and hence the LRR is estimated with VEC method. The CE shows that the coefficients of Phyinf and Fininf are positive, while that of Socinf is insignificant but negative (Table 4). On removing Socinf, the VAR system gives a better fit, and the coefficients are significant. Similar results are obtained with Inddev and Devt, where removal of Socinf gives a better fit. It seems that since Socinf has been following AR(3) process while the others are following AR(1) process, inclusion of Socinf affects the specification of the model. For Hudev however, presence of CE is not confirmed and we persist with Multivariate VAR. The results of the Multivariate exploration are summarised in Table 4. Most of the coefficients are significantly positive. The speed of adjustment is also significant in all three cases. It therefore follows that the infrastructural indices taken together affects the developmental indices significantly, and any short run inconsistency is speedily corrected. This again underlines the importance of a comprehensive infrastructural development programme for development of the state.

Summary Results and Impact of Individual Infrastructural Factors

The main features of the estimation results may be discussed further. The Long Run Multipliers can be obtained by adding up the Impact Multipliers or the coefficients of the lagged terms of the variables, for the VAR models. For the VEC models the multipliers are directly obtained from the CE.

It is observed that for agricultural and industrial developmental indices and for PCNSDP, the highest multiplier is associated with Transport infrastructure, indicating its prime importance in shaping the development profile of the region (Table 5). Multipliers of Physical infrastructure are greater than those of Financial or Social infrastructure. It thus follows that the authorities should attach adequate importance to development of physical infrastructure, especially those related to transport and power, to augment development levels in West Bengal. Agricultural infrastructure has generally low multiplier except for PCNSDP, where it has the second largest multiplier. If we now look at the magnitude of individual impacts, we find that improvements in Transport infrastructure leads to more than proportionate improvement in Agricultural and Industrial development, and the composite development index

Devt (the multipliers being greater than unity). The impact of the composite index of infrastructure (Infra) is observed to be highest for Human development, indicating the importance of infrastructural expansion for even the 'non-economic' dimension of development.

Using the factor loadings in the PCA and the estimated regression coefficients, the effect of increment in some of the key infrastructural indicators on development indices can also be worked out. For example, just 1% point rise in Irrigation Intensity can lead to 0.211 unit rise in agricultural development index, 0.107 point rise in composite development score Devt, and 651 rupees rise in PCNSDP. This translates into 6.5%, 4.7% and 18% increases from the 2001 levels of the indices respectively. The impacts of changes in some key variables are reported in Table 6. One outcome of this part of the study is that one can now judge the effectiveness of alternative policy changes on development and take appropriate steps. For example, it seems that improvement in transport indicators would work better than improvements in financial indicators in augmenting Inddev, while agricultural development will be better augmented by improvements in financial facilities rather than by conventional agricultural infrastructural facilities.

7. Conclusion and Policy Implications

The conclusions that can be drawn may be summarised as -

- Both developmental and infrastructural indices have shown a continuously rising trend during 1971-1995. Only Social infrastructure has shown an inverted U-shaped pattern.
- The Causation seems to be stronger from infrastructure to development, though in some cases bi-directional causality cannot be ignored.
- The long run relationships suggest strong positive impact of infrastructural availability on development levels.
- Differential impact of the various infrastructural sectors on sectoral and overall development level has been underlined.

The policy suggestions that emerge from this study can be briefly mentioned. It is quite obvious that infrastructural expansion is a necessary condition for development of the West Bengal economy. Moreover, different facets of infrastructure have different impacts on different dimensions of development. A segmented policy aiming at specific sectors need to be adopted with the greatest importance being attached to those infrastructural indicators that have highest total impact across agricultural, industrial and human development. For example, in our study, Transport and Power sectors emerge as most significant policy instruments having the strongest 'linkages'. Given

the poor condition of the roads, inadequate rural connectivity, low per capita power consumption and low PLF in the state, there are long strides to be taken in those areas. These would naturally lead to substantial improvement in the development levels in all the segments. However, further analysis using a multivariable VAR/VEC method or a comprehensive macroeconomic modelling should be attempted before these ideas can be given definite shape. This is one possible extension of the study. In addition, the relationships may be used to simulate and forecast the path of developmental indices under different assumptions regarding infrastructural expansion.

The bottom-line is that infrastructure has been playing a crucial role in shaping the development profile of West Bengal and this sector has to be carefully nurtured to reap the benefits of a stable administration and some sort of rural land redistribution that has already occurred here. Otherwise, the superstructure will have only a weak base and will come crashing down any day.

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Table 1
Direction of Causality - according to Granger Causality test

Unidirectional Causality		Bidirectional Causality	Indefinite Results	
Fininf → Agdev	Aginf → Hudev	Powinf ↔ Agdev	Aginf ?-? Agdev	Socinf ?-? Hudev
Infra → Agdev	Trinf → Hudev	Powinf ↔ Inddev	Trinf ?-? Agdev	
	Powinf → Hudev	Powinf ↔ Hudev	Phyinf ?-? Agdev	Trinf ?-? Devt
Aginf → Inddev	Phyinf → Hudev	Powinf ↔ Devt	Socinf ?-? Agdev	Fininf ?-? Devt
Powinf → Inddev	Fininf → Hudev			Socinf ?-? Devt
Phyinf → Inddev	Infra → Hudev	Aginf ↔ PCNSDP	Trinf ?-? Inddev	
Fininf → Inddev		Trinf ↔ PCNSDP	Socinf ?-? Inddev	Powinf ?-? PCNSDP
Infra → Inddev	Aginf → Devt	Phyinf ↔ PCNSDP		Fininf ?-? PCNSDP
	Phyinf → Devt	Infra ↔ PCNSDP		Socinf ?-? PCNSDP
	Infra → Devt			

Source: Author's Calculation.

Table 2 : Final Estimated Models – Developmental Indices regressed on Infrastructural Indices

Dependent Variables → Independent Variables ↓	Agdev	Inddev	Hudev	Devt	PCNSDP
Constant	1 257**	1.832**	1.859**	1.235**	729 6*
Trend					
Aginf					1623.6
Aginf(t-1)	0.526**	0.216**	0.319**	0 268**	
Model Specification	VAR	VAR	VAR	VAR	CE/LRR
Constant	-1 267*	0.639**	1.692**	0.537*	
Trend					
Trinf				3.419**	2010.0**
Trinf(t-1)	2.703**	0.882*	0.075**		
Trinf(t-2)	2.186**	1 429**			
Trinf(t-3)	0.199	0.004			
Model Specification	VAR	VAR	VAR	CE/LRR	CE/LRR
Constant	1 163**	1.586**	2.194*		269.0
Trend	0.066**	0.015	0.174		
Powinf			4.297**	1.852*	
Powinf(t-1)	0 046	0.248*			1130 0**
Model Specification	VAR	VAR	CE/LRR	CE/LRR	VAR
Constant				0.880	
Trend				0.003	
Phyinf	0 690*	0.729**	7.738	0 465**	1808.0**
Phyinf(t-1)					
Model Specification	CE/LRR	CE/LRR	CE/LRR	CE/LRR	CE/LRR
Constant	1.612*	2 491	1.632**	1.474*	
Trend					-65.0*
Fininf	0.614**	0.145*		0.297**	
Fininf(t-1)			0.425**		1597.0**
Model Specification	CE/LRR	CE/LRR	VAR	CE/LRR	VAR
Constant	1.373				
Trend					
Socinf					589.0*
Socinf(t-1)	0.363				
Socinf(t-2)					
Model Specification	VAR	VAR	VAR	VAR	CE/LRR
Constant		1 344			
Trend					
Infra	1.526**		1.724**	0.586*	3159.0**
Infra(t-1)		0.409**			
Model Specification	CE/LRR	VAR	CE/LRR	CE/LRR	CE/LRR

VAR – model estimated by VAR; CE/LRR – models from the Cointegrating equation; * and ** refers to significance at 5% & 1% levels respectively. Coefficients with significance level more than 10% are not reported.

Source: Authors' calculation.

Table 3 : Speed of Adjustment in Error Correction Models – Coefficients of Cointegrating Equation

Dependent Variables → Independent Variables ↓	Agdev	Inddev	Hudev	Devt	PCNSDP
Aginf					0.055**
Trinf				0.215*	0.126**
Powinf			0 051	0.022*	
Phyinf	0.063**	0 001	0.004	0.854**	0.090**
Fininf	0.132**	0.083	0.013	0.126*	
Socinf					0.129**
Infra	0.068*			0.009	0.016**

Note: * and ** refers to significance at 5% & 1% levels respectively. Coefficients with significance level more than 10% are not reported.
Source: Authors' calculation.

Table 4 : Multivariate Models – Developmental Indices regressed on All Three Infrastructural Indices

Dependent Variables → Independent Variables ↓	Agdev		Inddev		Hudev	Devt	
	Model 1	Model 2	Model 1	Model 2		Model 1	Model 2
Model Specification	CE/LRR	CE/LRR	CE/LRR	CE/LRR	VAR	CE/LRR	CE/LRR
Constant		0.223		0.490			0.550
Trend				0.108*			0 016
Phyinf	1 248**	0.958**	1.218**	1.122**		0.405**	0.720**
Fininf	0.023	0 183	-0.494*	0 774**		0.134*	0.103
Socinf	0.078		0.348**			-0.060	
Phyinf(t-1)					0.609**		
Fninf(t-1)					0.035		
Socinf(t-1)					0.556**		
Socinf(t-2)							
Speed of Adjustment	0.033	0.543*	0.129	0 227*		0.588*	0.280*

Note: VAR – model estimated by VAR; CE/LRR – models from the Cointegrating equation; Speed of Adjustment is the Coefficient of the Error Correction Term in VEC Models. * and ** refers to significance at 5% & 1% levels respectively. Coefficients with significance level more than 10% are not reported.
Source: Authors' calculation.

Table 5 : Final Multipliers on Developmental Indices for Changes in Infrastructural Indices

Dependent Variables→ Independent Variables↓	Agdev	Inddev	Hndev	Devt	PCNSDP
a Phyinf	0.690	0.729	7.738	0.465	1808.0
i. Aginf	0.526	0.216	0.319	0.268	1623.6
ii. Trinf	5.088	2.315	0.075	3.419	2010.0
iii. Powinf	0.046	0.248	4.297	1.852	1130.0
b. Fininf	0.614	0.145	0.425	0.297	1597.0
c. Socinf	0.363				589.0
Infra	1.526	0.409	1.724	0.586	3159.0

Note: Coefficients with significance level more than 10% are not reported and Multipliers are also not reported for them.

Source: Authors' calculation.

Table 6 : Impact of Increment in Different Instrumental Variables on Individual Development Indices

	Impact on				
Impacts of 1 unit increment in	Agdev	Inddev	Hudev	Devt	PCNSDP
Fertiliser consumption per hectare GCA	0.231	0.095	0.140	0.118	714.4
Irrigation Intensity	0 211	0.087	0.128	0.107	651.1
Bank Credit To Agriculture per hectare GCA	0 252	0.103	0.153	0.128	777.7
Power Consumed by Agricultural sector	0.339	0 139	0.206	0.173	1047 2
Road and Railway length per 1000 sq. km. Area	3.618	1.646	0 053	2.431	1429.1
% of Roads Surfaced	3.577	1 627	0.053	2.404	1413 0
% of Villages electrified	0 028	0.149	2.578	1.111	678.0
Per capita power generation	0.027	0.144	2 488	1.072	654.3
PLF	0 025	0 137	2 372	1.022	623.8
Bank branches per 1000 sq. km. area	0 312	0.074	0.216	0 151	811.3
Bank branches per lakh pop	0 300	0 071	0.207	0.145	779.3
	Impact on				
Impacts of 1 unit increment in	Agdev	Inddev	Hudev	Devt	PCNSDP
Bank credit to SSI	0.301	0.071	0.208	0.146	782.5
Per Capita SFC credit	0.315	0.074	0.218	0.152	819.3
Primary Schools per 1000 sq. km. Area	0 149				241.5
Secondary Schools per 1000 sq. km. Area	0.149				241.5
Per capita expenditure on Pr. Schools	0.148				240.9
Colleges per 1000 sq. km. Area	0.148				239.7
Hospitals per 1000 sq. km. Area	0.148				239.7
Medical Personnel as % of pop	0 147				239.1

Note: Impacts are obtained by multiplying individual Factor Loadings with the Final Multipliers from Table 3b Coefficients with significance level more than 10% are not reported and impacts are not assessed for them.

Source: Authors' calculation.

Arthaniti 3 (1-2), 17-29 / 2004

Forms of Dualism: An Analysis of the Structure of India's Unregistered Manufacturing Sector Based on the 56th Round Results

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Abstract

This paper delineates the structure of the unregistered manufacturing sector on the basis of data reported by the 56th Round of the NSS conducted during July, 2000 and July, 2001. The importance of unregistered manufacturing has increased significantly in employment terms, although its share has fallen in value added terms. The structure remains heavily biased in favour of small and organisationally "primitive" units. Distributions of enterprises by location, status of working, sales destination and other parameters are given.

Keywords : Forms of Dualism, unregistered manufacturing sector, organised sector.

Despite more than five decades of State-led industrial development, "dualism" or even "multi-structuralism" has been an abiding characteristic of India's industrial sector. Early analyses of the structure of industry at Independence had pointed to the domination of "lower forms of production" or production characterised by the use of non-power driven techniques and the absence of hired labour located predominantly in rural and semi-urban areas. Thus, according to national income data relating to 1948-49, "factory establishments" accounted for just 6.34 per cent of national income and 37 per cent of the national income generated in the mining and manufacturing sectors.[1] Further, going by the Census for 1951 factory establishments accounted for just 26 per cent of the employment in mining and manufacturing, which itself amounted to just 9.3 per cent of total employment.[2]

While organised sector units, or those that correspond with the criteria set by sections 2m(i) and 2m(ii) of the Factories Act, 1948 for registration, are not always units that meet the attributes expected of modern, industrial establishments, this is the closest one can get to making a division between the unorganised and organised or informal and formal that must necessarily be arbitrary. Moreover, since in law these units have to tally with the requirements of labour legislation in the country, there is at least one sense in which they could be termed formal or organised.

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1 Computed from CSO figures quoted in Reserve Bank of India (1956), **Report on Currency and Finance**, RBI: Bombay, p. 127.

2 Ref. Shirokov, G.K. (1973), **Industrialisation of India**, Moscow: Progress Publishers

Conventional wisdom based on developed-country experience would have it that the process of industrialisation is one in which an economy witnesses the gradual demise of excessively small units and units based on more primitive techniques and primitive forms of organisation, which give way to large or larger units working with hired labour and more advanced techniques and increasingly adopting the impersonal joint stock company form of organisation. It barely bears stating that state intervention to ensure minimum wage payments, a "normal" working day and reasonable conditions of work, by encouraging productivity enhancing technical change, would contribute to the above-described transition.

This would imply, as a corollary, that the implicit "exemption" from regulation of units that do not meet the criteria set by sections 2m(i) and 2m(ii) itself would slow the pace of "modernisation" and contribute to some degree of persistence of dualism. This is a factor that favours the use of the Factories Act definition to draw the dividing line between the organised and unorganised sectors. In addition, since historically the statistical system has sought to cover registered units through the ASI and unregistered units through the Economic Censuses and the follow–up surveys undertaken by the NSSO, a body of statistical evidence to assess the structure and evolution of the unregistered sector exists.

Needless to say, dualism is not a function of just the implementation of the Factories Act, allowing for wage differentials between the "organised" and "unorganised" sector. Rather, as analysts have often pointed out, a number of other factors on the demand side such as the persistence of "traditional tastes" that can be catered to only by more primitive techniques and the existence of poverty and inadequate market integration, which generate a different kind of "niche" market for cheap but primitive products, have also encouraged dualism. Further, inasmuch as poverty-related factors like unemployment and underemployment result in a constant search by the poor for supplementary work and barriers to entry into many areas of unorganised production are limited, the supply of commodities from these kinds of units tends to be elastic, with production at extremely low wages and prices that reflect small or negligible "margins" occurring as when these demands manifest themselves. In the event, the unregistered manufacturing sector would be characterised by three kinds of "instability" – that stemming from the fact that some of its activities are seasonal, that resulting from the high rate of mortality of unregistered units given the low wages, small margins and extreme competition characteristics of this sector, and that resulting from the precariousness of the demands they cater to.

Besides all this, backward techniques and backward forms of organisation survive also because of the subordination of these activities by merchant or trading capital, which is able to earn for itself a suitable margin even while remaining competitive with production based on modern techniques, because of its ability to exploit the

benefits of low wages associated with production in the unorganised or unregistered sector. This is particularly true of primitive production units that cater to national markets like handloom, beedi or match production. In fact the irrational concentration of match production in a few contiguous districts of Tamil Nadu, which account for an overwhelming share of the matches produced in the country and cater to markets nationwide, can only be explained by the evolution of a trading chain dominated by merchant capital that controls a complex, historically evolved production system involving home- and unit-based female and child labour that keeps cost of production extremely low.

Thus "dualism" or "multi-structuralism" is not a phenomenon determined primarily by the incidence or not of factory legislation, but the consequence of the larger socio-economic context and its evolution. The Factories Act merely provides the arbitrary dividing line that must be drawn between the organised and unorganised sectors, and provides an ambiguous contribution to difference between the two sectors. "Ambiguous" because, evidence on the implementation of the Factories Act does not generate confidence in the ability of the implementing mechanism to ensure minimum wages and reasonable conditions of work in the factories that are formally registered with the Chief Inspector of Factories.

This note has a limited objective: that of delineating the structure of the unregistered manufacturing sector on the basis of data yielded by 56th Round of the NSS conducted during July 2000 and July 2001. The NSS 56th Round broadly covered all unorganized manufacturing enterprises (UMEs) under the two digit codes 15 to 37 and enterprises under cotton ginning, cleaning and baling.[3] Out of these 5586 rural and 8942 urban units were finally surveyed. The Survey covered manufacturing enterprises (MEs) not covered in the Annual Survey of Industries (ASI)[4] [i.e. those not registered under Section 2m(i) and 2m(ii) of the Factories Act (FA), 1948], manufacturing enterprises registered under Section 85 of the FA, 1948, and enterprises manufacturing bidi and cigar that are not covered under the ASI.

The NSS estimates the total number of workers employed in the unregistered manufacturing sector at 3.71 crore in 2000-01. If we exclude the industries with NIC codes 01405 and 37, and compare the remaining industries with the same set of 22 two-digit industries in the ASI we find that while the number of workers in the unregistered sector in 2000-01 amounted to 3.7 crore, the total number of employees

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[3] The Survey covered almost the entire country except Leh and Kargil districts in Jammu and Kashmir, villages beyond five kilometers of bus routes in Nagaland, inaccessible villages in Andaman & Nicobar Islands, and some first stage units where EC 1998 couldn't be undertaken. A total of 14788 first stage units (5696 villages and 9092 urban blocks) were selected for the survey.

[4] Enterprises with power with ten people or less, or those without power with 20 people or less are left out of the purview of the Factories Act 1948.

in the registered factory sector amounted to 79 lakh workers in 1999-2000. Assuming no change in the number of workers between 1999-2000 and 2000-01 in ASI factories[5], the share of the unregistered sector in total manufacturing employment works out to 82 per cent. Similarly, gross value added in the unregistered sector of the 22 two-digit industries mentioned above in 2000-01 by the product approach works out to 24.3 per cent of gross value added in registered manufacturing in 1999-2000 and in unregistered manufacturing in 2000-01 combined.[6] (Interestingly, this is substantially different from the contribution of the unregistered sector to manufacturing GDP, which is placed by National Accounts Statistics at 35 per cent in 2000-01.) Clearly, if the figures relating to the immediate post-Independence years are reliable, the importance of the unregistered manufacturing sector has increased significantly in employment terms, even if its contribution has fallen in terms of value added shares.

While the unregistered sector accounts for a significant share of manufacturing employment and production, the structure of the sector remains heavily biased in favour of small and organisationally "primitive" units. Across the rural and urban areas, own account manufacturing enterprises (OAMEs) or those that employ no hired labour on a "regular basis" account for an overwhelming 86 per cent of all enterprises. Though the presence of OAMEs is greater in rural areas, their share in total enterprises in urban areas too amounts to a remarkable 71 per cent. Further, both in rural and urban areas, more than 70 per cent of the units employing hired workers are non-directory manufacturing establishments, or those employing less than six workers. Table 2 provides a picture of the two-digit industrial categories in which OAME's account for less than 80 per cent of all enterprises in rural areas and 66 per cent of all enterprises in urban areas. While in the rural areas there are just 7 of 24 industries covered by the 56th round that meet these stringent criteria, there are 14 out of 24 in urban areas in which less than two-thirds of the units are OAMEs. Further, these sectors account for less than 1 and 15 per cent respectively of all enterprises in rural and urban areas. Clearly the spread of production based on use of hired labour on a fairly regular basis is limited within the unregistered sector in both rural and urban areas.

Along with the persistence of small-sized units and non-hired labour based forms of organisation, the structure of the unregistered sector points to a relatively high degree of specialisation of activity when analysed in terms of two-digit categories. Thus as far as OAMEs are concerned as much as sixty per cent of units fall in the

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[5] We must recall that the total number of workers in ASI factories fell from 85.5 lakh to 81.7 lakh between 1998-99 and 1999-2000.

[6] Inflating the 1999-2000 ASI GVA figure using the rate of growth of that magnitude between 1998-99 and 1999-2000 to arrive at an estimate for 2000-01 and using that figure changes the ratio to 22.9 per cent as opposed to 23 4 per cent

food, tobacco, textiles and wearing apparel areas in both rural and urban areas. In rural areas, if we add wood and wood product units, the cumulative share rises to as much as 83 per cent. Thus, small OAMEs are concentrated in traditional areas such as food products, textiles and wood products, all of which are agro-based, rather than being chemical or metal based. Even when we consider NDMEs and DMEs, these sectors account for 60 to 75 per cent of the total in rural areas and around 45 per cent in urban areas. The other two areas with significant number of enterprises are non-metallic mineral products, especially in the DME category in rural areas, and fabricated metal products, excluding machinery and equipment. The former we must recall includes activities such as glass and glass products (including glass bangles), manufacture of ceramic ware, manufacture of bricks, manufacture of roofing tiles and manufacture of lime and plaster, which are all activities that fall within a broad definition of "traditional" and can be seen as predominantly catering to local markets.

The concentration of activity in these areas is visible even when assessed in terms of the share of employment in unregistered units in different two-digit industrial categories. Food, tobacco, textile and wood products account for between 50 and 82 per cent of employment in OAMEs and NDMEs and when we include non-metallic mineral products and fabricated metal products the ratios rise to 85 to 90 per cent for all kinds of units.

The primitive nature of a substantial segment of the unregistered manufacturing sector is also reflected in the fact that 70 per cent of all units are typically "household units" in the sense that they are located in household premises. This high proportion is of course explained primarily by the facts that OAMEs dominate the sector in terms of number of enterprises and as much as 80 per cent of OAMEs in rural areas and 70 per cent in urban areas are located in household premises. But what is noteworthy is the fact that 35 and 22 per cent of NDMEs in rural and urban areas respectively and 26 and 20 per cent of DMEs are household units. If operating out of permanent, non-household premises is taken as a minimal prerequisite for a unit being a "modern" small unit in the unregistered sector, then only a little more than a half of the small population of NDMEs and DMEs in rural areas and about three quarters of the NDMEs and DMEs in the urban areas would qualify as being units that are or are precursors of modern small firms.

Another way to situate and assess the character of the unregistered manufacturing sector would be to examine the degree and nature of its integration with the formal economy. This integration can occur either through financial, input-output or marketing linkages. These kinds of linkages may in fact complement each other with financially dependent small, unregistered units obtaining inputs from and supplying their outputs to large players who provide financial assistance. With nearly 50 per cent of units surveyed in the 56 round reporting "shortage of capital" as being a problem confronting

them , this kind of inter-linkage across finance, input and product markets is a real possibility.

It needs to be made clear at the outset that none of these need be always positive from the point of view of units in the unregistered sector. As mentioned earlier financial dependence could imply a kind of subordination to medium or large finance capital, especially in industries catering to large, state or national markets, which could have as its corollary relatively small margins as is known to be true in the case of the production of matches, bidis and handloom textiles. Input dependence on large, oligopolistic suppliers could also imply high input prices that squeeze margins in a sector where demand growth may be sluggish and competition intense. And dependence on supply of outputs as inputs for and products for marketing by large units can make the small units bear the brunt of the burden of any downturn (through delayed payments for example), or hard bargaining by oligopsonistic buyers who can squeeze margins substantially.

As Table 6 indicates, evidence yielded by the 56th round seems to suggest that inter-linkage between the formal and informal sectors is indeed present, even if not overwhelming. Thus 28 per cent of units in rural areas and 38 per cent of units in urban areas are working on contract, which is likely to be with units or capital from the formal sector. What is noteworthy is that in the rural areas and to a smaller extent in urban areas, the contract system is more prevalent among OAMEs than establishments, pointing to the possibility of penetration by merchant capital in search of cheap home-based production sources that ensure the required returns. This presumption is supported by the evidence that on average 80 per cent of enterprises working under the contract system enter into contracts solely with a master contractor/ enterprise.

Contractual links notwithstanding, it does not appear from the evidence that these links have dominated the choice of product markets for unregistered units. Thus, 65 per cent of rural units and 57 per cent of urban units reported that they sold some of their final outputs to private individuals or households. However, in the case of NDMEs and DMEs, sale of final output to private enterprises or contractors/middlemen was indeed quite prevalent. About 37 and 55 per cent of NDMEs and DMEs respectively in rural areas and 45 and 71 per cent respectively in urban areas reported such sales. That is some kind of input-output linkage and ancillarisation does seem to be widely prevalent.

In sum, we can think of two kinds of "dualism" with regard to the unregistered sector. First, the dualism with respect to the formal sector reflected in the persistence of units operating as household units with more primitive techniques, even while modern industry progresses, even if not in terms of employment generated. This kind of dualism need not however imply the lack of any linkages with the formal sector.

Rather financial, input-output and marketing linkages can exist. The persistence of backwardness may not just reflect the existence of the peculiar niche markets that low per capita incomes and poverty create but also the subordination of backward forms by capital from the formal sector, which treats a segment of the unregistered sector as a source of surplus even if that is at the expense of extremely low wages. Second, the dualism within the unregistered sector reflected in the signs of coexistence of backward units along with other units, especially among the NDMEs and DMEs, which are taking on characteristics of the ancillaries that are typical of any modern industrial environment. Analysts argue that the growth of these kinds of small units and their integration with the large scale sector through a process of "ancillarisation" is positive from the point of view of generating a modern, well managed small industrial sector.

The point to note is that while there is a strong positive relationship between the rank of a two-digit industrial sector in terms of estimated number of enterprises and estimated number of workers (with the rank correlation coefficient exceeding 0.9 in categories of units excepting NDMEs and DMEs in rural areas), there is virtually no relationship or at best an extremely weak relationship between the rank of an industry in terms of estimated number of workers and its rank in terms of value added per worker. While it could be argued that this should be "expected", what it does suggest is that in terms of number of enterprises and estimated workers, it is not the more productive units that predominate. Features of this kind emerging from this preliminary analysis of the 56th round results suggest that the Indian context is surprising inasmuch as the long experience with industrialisation has not undermined the former type of units, which in fact persist and even appear to dominate the landscape in the world of unregistered units.

Table 1: Distribution of enterprises by Category			
	OAME	NDME	DME
Rural	92.66%	5.27%	2.07%
Urban	70.88%	21.26%	7.86%
Combined	86.14%	10.05%	3.80%

Table 2 : Share of different categories of units in estimated number of enterprises in selected 2-digit industries

NIC Code		Rural			
		OAME	NDME	DME	Share in estimated enterprises
22	Publishing and reproduction of recorded media	61.61%	33.48%	4.91%	0.19%
23	Manufacture of coke, refined petroleum products and nuclear fuel	43.14%	47.06%	9.80%	0.04%
25	Manufacture of rubber and plastic products	71.51%	15.70%	12.50%	0.29%
27	Manufacture of basic metals	78.32%	11.89%	9.79%	0.12%
32	Manufacture of radio, television and communication equipment and apparatus	60.00%	20.00%	20.00%	0.01%
33	Manufacture of medical, precision and optical instruments, watches and clocks	60.00%	33.33%	6.67%	0.01%
34	Manufacture of motor vehicles, trailers and semi-trailers	69.44%	16.67%	16.67%	0.03%
NIC Code			Urban		
		OAME	NDME	DME	Share in estimated enterprises
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddler, harness and footwear	62 37%	25.09%	12.54%	1.66%
22	Publishing and reproduction of recorded media	35.86%	49.84%	14.31%	2.39%
23	Manufacture of coke, refined petroleum products and nuclear fuel	33.33%	55.56%	11.11%	0.04%
25	Manufacture of rubber and plastic products	40.98%	36.39%	22.46%	1.20%
27	Manufacture of basic metals	35.37%	48.37%	15.85%	0.48%
28	Manufacture of fabricated metal products, except machinery and equipment	42.46%	44.59%	12.95%	5 34%

29	Manufacture of machinery and equipment, n.e.c.	30.67%	47.24%	22.09%	1.67%
30	Manufacture of office, accounting and computing machinery		50.00%	50.00%	0.00%
31	Manufacture of electrical machinery and apparatus n e.c.	30.79%	33.10%	36.34%	0.85%
32	Manufacture of radio, television and communication equipment and apparatus	17.24%	34.48%	48.28%	0.11%
33	Manufacture of medical, precision and optical instruments, watches and clocks	45.07%	36.62%	18.31%	0.14%
34	Manufacture of motor vehicles, trailers and semi-trailers	13.90%	47.59%	38.50%	0 37%
35	Manufacture of other transport equipment	28.57%	38.39%	33.04%	0.22%
37	Recycling	64.04%	20.22%	15.73%	0.17%

Table 3: Cumulative Distribution of Enterprises by 2-digit catagorization

NIC Code		Rural			
		OAME	NDME	DME	ALL
15	Manufacture of food products and beverages	19.03%	30.28%	26.65%	19.78%
16	Manufacture of tobacco products	33.64%	32.30%	34.59%	33.59%
17	Manufacture of textiles	47.68%	46.94%	52.94%	47.75%
18	Manufacture of wearing apparel, dressing and dyeing of fur	61.65%	66.02%	55.16%	61.75%
20	Manufacture of wood and of products of wood and cork, except furniture, manufacture of straw and plating materials	83.38%	74.95%	58.32%	82.41%
26	Manufacture of other non-metallic mineral products	88.75%	80.44%	81.77%	88.17%
28	Manufacture of fabricated metal products, except machinery and equipment	91.69%	86.91%	83.72%	91.28%

NIC Code		Urban			
		OAME	NDME	DME	ALL
15	Manufacture of food products and beverages	12.54%	14.58%	10.09%	12.78%
16	Manufacture of tobacco products	25.06%	14.84%	10.44%	21.74%
17	Manufacture of textiles	39.53%	25.26%	32.66%	35.96%
18	Manufacture of wearing apparel, dressing and dyeing of fur	63.68%	45.56%	44.63%	58.32%
20	Manufacture of wood and of products of wood and cork, except furniture, manufacture of straw and plating materials	71.05%	51.35%	48.80%	65.11%
26	Manufacture of other non-metallic mineral products	73.61%	53.57%	53.05%	67.73%
28	Manufacture of fabricated metal products, except machinery and equipment	76.80%	64.77%	61.84%	73.07%
NIC Code		Combined			
		OAME	NDME	DME	ALL
15	Manufacture of food products and beverages	17.43%	20.35%	16.41%	17.69%
16	Manufacture of tobacco products	31.53%	21.26%	19.66%	30.05%
17	Manufacture of textiles	45.67%	33.23%	40.39%	44.22%
18	Manufacture of wearing apparel, dressing and dyeing of fur	62.15%	53.08%	48.64%	60.73%
20	Manufacture of wood and of products of wood and cork, except furniture, manufacture of straw and plating materials	80.35%	60.03%	52.43%	77.24%
26	Manufacture of other non-metallic mineral products	85.03%	63.45%	64.00%	82.06%
28	Manufacture of fabricated metal products, except machinery and equipment	88.03%	72.91%	70.17%	85.83%

Table 4: Cumulative Distribution of Employment by 2-digit categorisation					
NIC Code		**Rural**			
		OAME	**NDME**	**DME**	**ALL**
15	Manufacture of food products and beverages	20.98%	29.20%	20.32%	21.56%
16	Manufacture of tobacco products	33.86%	31.71%	28.10%	32.99%
17	Manufacture of textiles	49.98%	48.34%	44.10%	49.14%
18	Manufacture of wearing apparel, dressing and dyeing of fur	60.15%	64.85%	45.47%	58.75%
20	Manufacture of wood and of products of wood and cork, except furniture, manufacture of straw and plating materials	82.33%	73.80%	47.49%	77.42%
26	Manufacture of other non-metallic mineral products	89.63%	79.99%	83.52%	88.11%
28	Manufacture of fabricated metal products, except machinery and equipment	92.32%	86.33%	84.76%	90.93%
NIC Code		**Urban**			
		OAME	**NDME**	**DME**	**ALL**
15	Manufacture of food products and beverages	14.40%	13.56%	9.21%	12.76%
16	Manufacture of tobacco products	25.28%	13.81%	9.63%	17.85%
17	Manufacture of textiles	42.86%	25.68%	33.21%	35.48%
18	Manufacture of wearing apparel, dressing and dyeing of fur	62.16%	44.51%	45.69%	52.80%
20	Manufacture of wood and of products of wood and cork, except furniture, manufacture of straw and plating materials	69.15%	50.16%	49.19%	58.47%
26	Manufacture of other non-metallic mineral products	72.80%	52.48%	54.44%	62.19%
28	Manufacture of fabricated metal products, except machinery and equipment	76.62%	63.85%	62.07%	69.14%

Tabke 5: Percentage distribution of manufacturing enterprises by location, separately by type of enterprises and sector								
	Percentage of enterprises							
Location of enterprise	rural India				Urban			
	OAME	NDME	DME	All	OAME	NDME	DME	all
within hh. premises	79.6	35.0	26.1	76.2	69.5	22.0	19.7	55.5
outside hh.premises: with fixed location	15.0	62.4	73.8	18.8	25.7	76.6	80.2	41.1
a) permament structure	12.4	57.5	54.3	15.7	23.7	75.2	78.2	39.0
b) temporary structure	1.2	3.6	7.7	1.5	0.9	1.0	1.2	1.0
c) without any structure	1.4	1.3	11.8	1.6	1.3	0.4	0.8	1.1
without fixed location	5.4	2.6	0.1	5.1	4.6	1.4	0.2	3.6
a) mobile market	1.6	0.8	0.0	1.5	0.9	0.4	0.0	0.7
b) street vendor	3.8	1.8	0.1	3.6	3.7	1.0	0.2	2.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 6: Percentage distribution of manufacturing enterprises by status of working on contract, separately by sector and type of enterprise									
Status	percentage of enterprises								
	rural India			urban India			all India		
	OAME	establishment	all	OAME	establishment	all	OAME	establish ment	all
working on contract	28.0	21.7	27.6	38.8	35.9	37.9	30.7	30.5	30.7
Not working on contract	72.0	78.3	72.4	61.2	64.1	62.1	69.3	69.5	69.3
all	100.0	100.0	100 0	100.0	100.0	100.0	100.0	100.0	100.0

Table 7: Percentage distribution of manufacturing enterprises working on contract, by type of contract, separately by sector and type of enterprise									
type of contract	percentage of enterprises								
	rural India			urban India			all India		
	OAME	establish ment	All	OAME	establish ment	All	OAME	establish ment	all
1. Solely for master enterprise/ contractor	81.9	66.4	81.0	81.4	64.7	77.0	81.8	65.1	79.6
2. Mainly on contract but also for other customers	6.5	17.1	7.1	8.9	20.0	11.9	7.3	19.2	8.9
3. Mainly / solely for customer	10.7	16.3	11.0	9.1	14.8	10.5	10.2	15.2	10.8
all(including not recorded cases)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 8: Percentage of manufacturing enterprises by destination agency for sale of final output									
		separately by sector and type of enterprise							
Destination agency for sale of final product/services	Percentage of enterprises								
	rural India					Urban			
	OAME	NDME	DME	all		OAME	NDME	DME	all
1. Government	0.2	0.6	5.9	0.3		0.3	0.3	1.1	0.3
2. Co-operative	1.0	2.0	2.3	1.1		0.8	0.5	0.6	0.7
/marketing society									
3. Private enterprise	26.6	37.0	55.2	27.8		33.6	45.0	71.1	38.9
4. Contractor/middleman	18.7	6.8	11.6	18.0		16.0	9.6	12.1	14.3
5. Pvt.individual/household	64.8	70.7	48.6	64.8		59.1	61.7	30.7	57.4
6. Others	2.2	1.8	1.7	2.1		2 0	1.6	1.3	1.9

Arthaniti 3 (1-2), 30-48 / 2004

Does Economic Development Cause Intra-Industry Trade? The Case of India: 1971 to 2000*

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Abstract

India's intra-industry trade (IIT) is evaluated and analyzed from 1971 to 2000. IIT is found to have an upward trend with a growth rate that is close to the growth rate of GNP. A host of macro economic indicators are cointegrated with IIT suggesting that there is a stable relationship between IIT and the level of economic development of India. The causation of this relationship is not however unidirectional as the existing theoretical literature on IIT suggests. There is bi-directional causality for these variables. This implies that though economic development boosts IIT, it can equally be interpreted as a proxy for economic development and a predictor of future industrial progress rather than one that strictly follows it.

JEL Classification : F12

Keywords : Intra Industry Trade, Economic Development, Causality.

1. Introduction

It is generally believed that the level of economic development of a country is positively related to the extent of intra industry trade (IIT). However the analytical question is: does economic development cause IIT? The suggestion in the literature seems to be in the affirmative. Such an argument, for example, can easily be constructed from Krugman (1981) where IIT positively depends on the extent of horizontal product differentiation and economies of scale factors that are positively influenced by economic development. Also in many models [including the above one and, say, the vertical IIT model suggested by Shaked and Sutton (1989)] there is a positive relationship between IIT and the level of purchasing power of the consumer. At the empirical level, research work by many authors like Havrylyschyn and Civan (1983), Helpman (1987) and more recently Bhattacharyya (2002) has explicitly confirmed this relationship between IIT and economic development by using multiple regression methods on cross-country data over different periods of time. Also, it has been repeatedly shown that for roughly the same years IIT in DCs are much greater than that in LDCs [see, for example, Tharakan (1986), Havrylyschyn and Civan (1983),

* An earlier version of this paper was presented at the Indian Statistical Institute, Bangalore. We are indebted to the participants of the conference for their comments. We are especially indebted to Dipankar Coondoo for his detailed comments on an earlier version of this paper. Excellent research assistance provided by Tanusree Bhattacharya and Satadru Chakraborty is gratefully acknowledged.

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Globerman and Deane (1990)]. These empirical and theoretical results apparently seem to complement each other and decisively establish the relationship between economic development and IIT. In reality, however, this is not generally true. The theoretical works not only imply a positive relationship but also implicitly argue in favor of a one-way causation from economic development to IIT. The empirical results on the other hand are silent on the issue of dynamic causation. In this paper we look at the time series data of a less developed country (India) to address this issue. Since country specific studies of IIT in LDCs are extremely rare[1], the paper is also expected to be informative regarding the magnitude, trend and determinants of IIT in these countries[2].

The rest of the paper is arranged as follows: in the next section we take a look at India's IIT data to study some of its broad characteristics. We also justify our choice of variables to be used in the regression analysis and report the simple correlation results with these variables. Section 3 presents the results of the unit root, cointegration and causality analysis. Section 4 concludes the paper.

2. IIT in India

2.1 The basic data

In line with the general trend in case of less developed countries, there has been very little effort to study IIT in India. Bhattacharyya (1994) presented a time series data for India's IIT between 1971 and 1987. The paper concluded that (1) about 20 to 24 per cent of total trade in India is intra-industry in character and there is a positive time trend to the data, (2) among the different categories of industries considered, manufactured products (SITC 6) had the highest amount of IIT and (3) India's bilateral IIT appears to be higher with developed rather than with less developed trading partners. However, the paper did not comment on the determinants of IIT in the context of India thus missing out crucial insights into the nature and characteristics of her IIT[3].

Table 1 and figure 1 report the value of the Grubel-Lloyd (uncorrected) index ($I_{GL(U)}$) first suggested by Grubel and Lloyd (1975)) for India between 1971 and 2000. The index is defined as follows:

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[1] There has however been a lot of work on groups of less developed countries like the Transition countries (see Aturupane, Chonira, et al (1999), Kandogan (2003) and others).

[2] For more on IIT in developing countries see, for example, Clark and Stanley (1999) and Ekanayake (2001).

[3] Panchamukhi (1997) observes that IIT for India is higher in natural resource intensive and human capital-intensive products than in labour intensive and technology intensive products. However, for a cross section data on Indian Industries in 1990, he finds no evidence of any statistically significant relationship between economies of scale and labour intensity of products to IIT.

$$I_{GL(U)} = 1 - \frac{\sum_i |X_i - M_i|}{\sum_i (X_i + M_i)}$$

Where X_i and M_i are the export and import values of the ith industry[4]. The value of the index varies from zero (no IIT) to 1 (all trade is IIT). The time trend and the growth rate of the series can be inferred from the following equations:

$$IIT_t = \underset{(11.4)}{0.17} + \underset{(7.8)}{0.006t} \qquad (1)$$

$\bar{R}^2 = .67$ F = 61.09

$$\text{Ln } IIT_t = \underset{(-29.6)}{-1.77} + \underset{(7.8)}{0.03t} \qquad (2)$$

$\bar{R}^2 = .68$ F = 62.1

The first equation suggests that IIT in India clearly has a positive time trend. Its growth rate over time is about 3 per cent per annum. Interestingly this growth rate is very close to the average annual growth rate of GNP over the same period (the so called 'Hindu rate of growth'). However the estimate of the slope coefficient in a regression with IIT as the dependent variable and GNP as the independent variable has fallen over the decades[5]. This is also obvious from table 2 where we regress IIT with GNP and report the actual and the predicted values of IIT when the decade of the 1980s is predicted from the nature of the relationship from the 1970s and that for the 1990s from that of the 1980s. It can be seen that in all cases the predicted value of IIT is much higher than the actual value confirming the fall in slope.

Table 3 compares India's IIT with some other less developed countries. On an average about 27 per cent of total trade was intra-industry in character in the countries reported in the table. It should be noted that among the countries chosen India has the lowest per capita GNP but it ranks sixth as far as IIT is concerned. Thus economic development is not the only criteria determining the magnitude of IIT. Turning to the commodity composition of IIT in India we find that Manufactured goods (SITC 6) accounts for the highest amount of IIT (48.7%) followed by machinery and transport equipment (SITC 7) (27.9%) and then chemical products (SITC 5) (18.7%). The overwhelming importance of SITC 6 is also confirmed from table A.1 in the appendix where it is seen that *all* industries with high bilateral IIT with different countries are of this category. Finally turning to the direction of India's IIT it can be seen from table 4 (and table A.1 in the appendix) that India's IIT is overwhelmingly with developed

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[4] The raw data for calculating the IIT values has been taken from the various issues of the International Trade Statistics Yearbook.

[5] The coefficient changes from .00019 in the 1970s to .00005 in the 1980s to .0000057 in the 1990s.

rather than underdeveloped countries. USA, UK and Singapore are the three largest IIT partners of India. To the extent that these countries are also India's major trading partners, India's bilateral IIT suggests a positive relationship between IIT and the trade volume of a country.

2.2 Determinants of IIT

Some of the standard determinants of IIT in developed countries (DCs) are. (1) Variables that affect export, or the supply side variables proxying for industrial structure, notably (a) the extent of economies of scale (b) the extent of horizontal product differentiation and/or (c) the extent of vertical differentiation. (2) Variables that affect import, or the demand side variables such as average purchasing power of consumers. (3) Policy variables like tariff. It should however be noted that the variables that are usually found to be relatively important for DCs do not automatically qualify as probable candidates for a LDC.

High levels of industrial concentration, small number of varieties for a product and little or non-existent scale advantages for the average industrial firm usually characterizes the production structure in LDCs such as India (see, for example, Rodrik (1988)). Firms in India typically have a low and declining propensity to adapt to foreign technology, low level of R & D expenditure (Katrak, 1985) and as a result lower levels of competitiveness compared to foreign firms (Kathuria (1995)). Here firms are even known to have negative externality in the core sectors (Patibandla 1992). Thus, the so-called 'supply side' variables need to be modified or replaced by more general variables that are meaningful. In our context, given our broad emphasis on economic development, one such variable is the size of the manufacturing sector (MANU). We consider this as the 'supply side' variable (determining the level of production) which proxies for economic development from the supply side.

Secondly, since it has been observed that LDCs such as India have higher IIT with DCs rather than LDCs, not only exports in general, but also export to DCs would be of special importance. Thus, a high and rising IIT with DCs should imply that goods are more and more conforming to the market demands of these countries. Relatively more capital or technology intensive goods have a larger market in DCs. This means that the level of capital intensity of the goods should determine the pattern of production from the supply side and hence the extent of IIT in countries like India. It is also a broad indicator of economic development implying industrial sophistication. We thus choose the capital-labor ratio (denoted by KL) over economies of scale and the extent of product differentiation to define industrial structure in the regression analysis below.

From the demand side, for obvious reasons, we have retained the variable that is considered for DCs, that is Gross National Product per capita (GNP). Also as a

policy variable we have retained tariffs (TARF) for this section. Unlike in the case of DCs, the variable, for a country like India, is of indeterminate sign. On the one hand tariffs by hindering trade in general also hinders IIT. On the other hand, tariffs by giving protection to domestic industries enhances its production and possibility of export, which coupled with the fact that there is usually a large demand for foreign industrial goods in LDCs like India may well lead to an increase in IIT. Finally, we have added the role of foreign direct investment (FDI) as an additional cause of IIT in LDCs such as India[6]. Table 5 presents the proposed causal determinants of IIT and their respective data sources.

2.3 Adjusting the data

Let us now turn to see whether we can establish any relationship between the explanatory variables and IIT[7]. For this we conduct a simple correlation analysis on IIT in India. In doing so, however, we need to keep in mind that our ultimate objective is drawing conclusions regarding causality through regression techniques. Since IIT is a positive fraction the application of OLS regressions will lead to erroneous results.

To overcome this problem Bergstrand (1983) suggests a logit transformation:

$$IIT_i = [\{\exp(x_i'\beta)\} / \{1 + \exp(x_i'\beta)\}].u_i \qquad (3)$$

where u_i's are homoscedastic disturbance terms. This implies that:

$$\begin{aligned} \ln \{ IIT_i / (1 - IIT_i)\} &= x_i'\beta + \ln \{u_i / (1 - u_i)\} \\ &= x_i'\beta + e_i \text{ (say)} \end{aligned} \qquad (3')$$

Assuming $Z_i^1 = \ln \{ IIT_i/(1-IIT_i)\}$ we regress Z_i^1 on the independent variables. However, for the transformed regression the random error term $e_i = f(u_i) \sim N(\theta, f' \delta_u^2)$. Thus, $V(e_i) = \sigma_u^2/\{ IIT_i/(1-IIT_i) \}$ and the transformed model has heteroscedastic disturbances. So, while running the regression we will have to apply $\{ IIT.(1 - IIT)\}^{1/2}$ as weights[8]. So the series that we will be working with ultimately is an adjusted version of the actual series (AIIT).

2.4 A Simple Correlation Analysis

Since adjusting a series in the above fashion distorts the series to a large extent it is useful to look at the simple correlation between the dependent and the independent

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[6] FDI in India has been very low for the last forty years mainly because the government has actively discouraged it In the 1980s the annual average rate of FDI inflow was only about 92 million dollars. Most of these had come through foreign capital participation in collaboration agreements.

[7] Note that through out this paper financial years have been made consistent with calendar years by taking, say, the 1971-72 data as the data for 1971 (in which it has nine months) and not 1972 (in which it has three months).

[8] It should be noted that adjusting the data set in the above manner has certain (restrictive) implications regarding the rate of fluctuation of the dependant variable with respect to the independent variables

variables of both the actual and the adjusted series. This would help us to determine whether the nature of the relationship between the two has been significantly affected due to the adjustment. This will also help us to get an indication about the results that we should expect from the regression analysis. Tables 6 and 7 report the simple correlation results both with and without adjustment. It can be seen from the tables that *both before and after adjustment* all the independent variables, except tariff, have a significant correlation with IIT. Thus the nature of the relationship between the dependent and the independent variables has not been affected by the adjustment of the data. The tables also suggest that there should be a strong statistical link between the extent of economic development and IIT in India, though such a link may not exist for trade policies like tariff.

3. Results for the Time Series Analysis

3.1 Unit root tests

To take a closer look at the IIT series we first determine its nature and order of stationarity. We use the usual three following equations to do this:

$$\Delta Y_t = \gamma Y_{t-1} + u_t \tag{4}$$

$$\Delta Y_t = \alpha + \gamma Y_{t-1} + u_t \tag{5}$$

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + u \tag{6}$$

where Δ is the first difference operator and in all cases we test for the null hypothesis of $\gamma=0$ (presence of unit root) against the alternative of $\gamma<0$. Acceptance of H_1: $\alpha \neq 0$ implies the presence of a drift in the series and acceptance of H_1: $\beta \neq 0$ implies the presence of a trend in the series. Table 8 reports the estimates of equations (5) and (6). A one period lag had to be used to eliminate autocorrelation in the equations as is testified by the LM values in column 5 of the table. The ϕ_1, ϕ_2 and ϕ_3 values respectively test for $(\alpha,\gamma) = (0,0)$ in equation (5) and for $(\alpha,\beta,\gamma) = (0,0,0)$ and $(\alpha,\beta,\gamma) = (\alpha,0,0)$ in equation 6. Turning to ϕ_3 first, the table value for rejecting the null hypothesis is 10.61 for 25 observations and 9.31 for 50 observations (see Hamilton (1994) page 764). Since the number of observations here is 30 in our case we use the first of these table values. The test thus points out the presence of unit root in the IIT series. The conclusion is further strengthened by looking at the ϕ_1 tests whose table value for 25 observations is 7.88. The ϕ_2 test confirms the presence of a drift in the series (table value for 100 observations in 4.88, see Holden and Perman (1994), page 100). The t-tests for $H_o=0$ vs $H_1<0$ for γ also confirm the same conclusion (see Fuller (1976) table 8.5.2). Thus we conclude that the IIT series has a unit root (see also figures 2-4).

A similar exercise with the first difference of the IIT series shows that ΔIIT (plotted in fig 2) is stationary. This test and all such tests with the independent variables are summarized in table 9. It can be noted from the table that all the variables are I(1) except TARF which is I(2).

3.2 Cointegration

Before coming to the cointegration results it should be noted that in view of the high correlation between MANU, GNP and KL (which are all I(1)) as reported in table 7) muticollinearity is a potential problem to be encountered in the cointegrating regressions. To avoid this problem we consider the variables separately in the cointegrating regressions[9]. The Johansen method of cointegration for the above variables has been used. The results are reported in table 10. It can be seen that all the independent variables except TARF cointegrate with IIT. However since MANU and GNP have more than one cointegrating vectors as opposed to a single one for KL, we can say that the relationship between IIT and KL is less "stable" (See Dickey, Jansen and Thornton (1994) page 22) than the rest of the variables. The failure of TARF was in fact imminent from tables 6 and 7 where the simple correlations with variables having high correlations with IIT were also very low. Its failure implies that trade policy has not significantly affected IIT in India and that other factors have overwhelmed it. It should be noted that the result could also be due to the fact that we have used a proxy for TARF (see table 5). However since TARF is not an indicator for economic development this does not affect our basic contention regarding the positive relationship between economic development and IIT.

3.3 Causality

We use the error correction model to test for causality (see Mehra (1994) page 154). The steps are as follows: first estimate a set of equations similar to the second step of the Engle-Granger procedure (for this discussion we assume that x_t and y_t are both I(1)):

$$x_t = \alpha_0 + \beta_0 y_t + v_{1t} \tag{7}$$

$$y_t = \alpha_1 + \beta_1 x_t + v_{2t} \tag{8}$$

After calculating v_{it} from the above we estimate the following error correction equations:

$$\Delta x_t = a_3 + \lambda_1 v_{1\,t-1} + \sum_s \beta_{1s} \Delta x_{t-s} + \sum_s \beta_{2s} \Delta y_{t-s}$$

$$\Delta y_t = a_4 + \lambda_2 v_{2\,t-1} + \sum_s \beta_{2s} \Delta x_{t-s} + \sum_s \beta_{1s} \Delta y_{t-s}$$

[9] Correlation with ΔATARF (which is I(1)) is -.31 (GNP), -.32 (MANU) and - 34 (AKL).

Where λ_1 and λ_2 are error correction coefficients. If $\lambda_1 \neq 0$ then y_t Granger causes x_t and if $\lambda_2 \neq 0$ x_t Granger causes y_t (since v_{it-1} depends on lagged levels of the ith variable, i = 1,2) Further if $\beta_{2s} = 0$ then lagged y_t's (x_t's) do not enter the x_t (y_t) equation.

The results of this test are presented in table 11. It can be seen that generally not only is there causality from the variables to IIT but reverse causality is also clearly present from IIT to the variables. Thus IIT is indeed caused by economic development and the process of causation is a complex one, as proxies of economic development do not cause it unidiretionally. In this sense it apparently seems to behave more like a parameter that itself has a role to play in the development process of the nation. Since, as we have already pointed out, economic theory implicitly suggests a one-way causation form the different variables signifying economic development to IIT, the second implication of the result seems to be rather surprising. However, let us note that Granger causality has a thematic implication that is not always appreciated while interpreting results derived from it (see Hamilton (1994) page 11). By its very statistical nature Granger causality is a tool that comments on the extent to which a series can forecast the values of another series. This ability to forecast may well translate into causality if economic logic supports it. If economic logic dictates something which is quite contrary to what the Granger causality analysis suggests, then all we can say is that the series contains "the market's best information as to where (the explained series) might be headed" (Hamilton(1994) page 307). The reverse causation from IIT to GNP and MANU in this interpretation is thus a reflection of the fact that it is itself an indicator of economic development and can be considered as an yardstick for it.

4. Conclusion

As an economic phenomenon IIT is a relatively recent discovery, its presence being almost unknown before the mid 1970s. Much is yet to be determined regarding the nature and causes of such trade between nations. One interesting issue that has been sparsely analysed in the literature is the nature of IIT in LDCs and its relationship with the level of economic development. In this paper we have investigated this issue with the Indian data. We have found that, in India, IIT is present, has an upward trend and has a positive relationship with economic development but the nature of the linkage is complex rather than a straightforward one. Though economic development boosts IIT, it can equally be interpreted s a proxy for economic development and a predictor of future industrial progress rather than one that strictly follows it.

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Table 1: India's IIT: 1971 - 2000

YEAR	IIT	YEAR	IIT
1971	0.143	1986	0.237
1972	0.142	1987	0.285
1973	0.151	1988	0.346
1974	0.161	1989	0.355
1975	0.176	1990	0.301
1976	0.215	1991	0 311
1977	0.259	1992	0.354
1978	0.311	1993	0.351
1979	0 226	1994	0.256
1980	0.222	1995	0.27
1981	0.218	1996	0.34
1982	0.249	1997	0.302
1983	0.279	1998	0.317
1984	0.242	1999	0.365
1985	0 231	2000	0.339

Source: Calculated from the International Trade Statistics Yearbook, UN, (various issues).

Table 2: Static Forecasts of IIT Based on OLS Regression of IIT on (Intercept and) GNP

YEAR	ACTUAL	PREDICTED	U^1_t	σ_u^2
Based on 1971 to 1979 data				
1980	0.222	0.267	-0.045	0 021
1981	0 218	0.310	-0.092	0.024
1982	0.249	0.314	-0.065	0.024
1983	0.279	0.377	-0.098	0.029
1984	0.242	0.402	-0.160	0.031
1985	0.231	0.431	-0.200	0.034
1986	0.237	0.456	-0.219	0.037
1987	0.285	0.475	-0.190	0.038
1988	0.346	0.580	-0.235	0.049
1989	0.355	0.647	-0.292	0.056
Based on 1971 to 1989 data				
1990	0.301	0 371	-0.070	0.040
1991	0.311	0.366	-0.055	0.040
1992	0.354	0.384	-0.030	0.041
1993	0.351	0.405	-0.054	0.043
1994	0.256	0.437	-0.181	0.046
1995	0 270	0.471	-0 201	0.049
1996	0.340	0.513	-0.173	0.054
1997	0.302	0.535	-0 233	0.056
1998	0 317	0.570	-0.253	0.060
1999	0.365	0.606	-0.241	0.065
2000	0.339	0.635	-0.296	0 068

Notes: 1. Error 2. Standard Deviation of error. Computed value of the F statistic for predictive failure test: F (10, 7) = 4.72* for IIT and 1.07 for ΔIIT (for the first regression) F(3, 17) = 3.17* for IIT and 2.67 for ΔIIT (for the second regression) where '*' implies F values are statistically significant at 5%.

Table 3: India's IIT compared to some other LDCs and NICs (1992)

COUNTRY	IIT	COUNTRY	IIT
1.PAKISTAN	0.031	10.PHILIPPINES	0.282
2.PERU	0.037	11.MEXICO	0.296
3.CHILE	0.084	12.BRAZIL	0.323
4.COLOMBIA	0.121	13.INDIA	0.354
5.SRILANKA	0.123	14.THAILAND	0.355
6.VENEZUELA	0.126	15.KOREA	0.433
7.INDONESIA	0.136	16.MALAYSIA	0.489
8.ARGENTINA	0.202	17.SINGAPORE	0.676
9.URUGUAY	0.217	18.HONG KONG	0.796

Source: Calculated from the International Trade Statistics Yearbook, UN, (various issues).

Table 4: India's Bilateral IIT with Selected Countries (1992)

COUNTRY	IIT
Developed countries	
USA	0.218
SINGAPORE	0.194
UK	0.179
ITALY	0.167
GERMANY	0.152
JAPAN	0.130
HONG KONG	0.098
SWITZERLAND	0.087
NETHERLANDS	0.084
Underdeveloped countries and NICs	
MALAYSIA	0.094
KOREA	0.080
THAILAND	0.074
BRAZIL	0.035
CHINA	0.029
BANGLADESH	0.023
PAKISTAN	0.008
SRILANKA	0.007

Source: Calculated from International trade statistics (Series D) (UN)

Table 5: Explanatory Variables and their Data Sources

	VARIABLE	PROXY	DATA SOURCE
1	The size of the manufacturing sector	Index no. of manufacturing production in India (MANU)	Economic Survey (Govt. of India)
2	The capital intensity of industrial goods	Productive capital per worker per factory in Indian manufacturing (KL)	Calculated from the Annual Survey of industries (Govt. of India)
3	Average purchasing power	Gross national product per capita in India (GNP)	Economic Survey (Govt. of India)
4	Tariffs	Ratio of total customs duty earned by the Govt. of India to the import bill (TARF)	Calculated from the Reserve Bank of India Bulletin

Table 6: Correlation Matrix of Independent Variables at Level

Variables	IIT	MANU	GNP	TARF
MANU	.739**			
GNP	.748**	.998**		
TARF	-0.003	-0.325	-0.346	
K/L	.665**	.986**	.985**	-.435*

Notes: 1. Pearson correlation 2.** Correlation is significant at the 0.01 level (2-tailed). 2. * Correlation is significant at the 0.05 level (2-tailed). 3. No. of observations 30.

Table 7: Correlation Matrix of the Adjusted Series at Level

Variables	AIIT	AMANU	AGNP	ATARF
AMANU	.782**			
AGNP	.837**	.994**		
ATARF	0.260	-0.112	-0.075	
AKL	.689**	.982**	.965**	-0.258

Notes: 1. Pearson correlation 2.** Correlation is significant at the 0.01 level (2-tailed). 2. * Correlation is significant at the 0.05 level (2-tailed). 3. No. of observations 30.

Table 8: Unit Root Tests for AIIT Series

α	β	γ	θ	LM_1^2	ϕ_1	ϕ_2	ϕ_3
-0.11		-0.28	0.08				
(-1.4**)		(-1.7)	0.73	0.1	3.7		
-0.49	0.008	-0.83	0.36	0.4		7.5**	10.0
(-3.7**)	(3.1**)	(-4.0)	(1.9**)				

Notes: 1. The estimated model has a one period lag, hence it is : $\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \theta \Delta y_{t-1} + \varepsilon_t$. 2. LM_1 is the Lagrange multiplier test statistic for serial correlation (F version, Order 1).

Table 9: Unit Root Test for the Dependent and the Independent Variables[1]

Variable	LM [2]	Level	First diff.	Second diff.	Conclusion
IIT	.41*[4]	-2.16	-6.24	NA	I(1)[3]
GNP	2.27	0.96	-4.6	NA	I(1)
MANU	0.95	2.21	-2.98	NA	I(1)
KL	0.35	-0.75	-3.66	NA	I(1)
TARF	1.35	-1.14	-2.83	-4.81	I(2)

Notes: 1. There is trend in the data generating process for GNP and KL and no-trend in IIT, MANU and TARF (Results not reported). Accordingly appropriate Dickey Fuller statistic is reported (i.e, 'Dickey Fuller Statistic with trend' or 'Dickey Fuller statistic without trend'). Also since serial correlation is present in the basic Dickey-Fuller equation in all cases we use the Augmented version of the test in all cases. 2. LM gives the Lagrange multiplier statistic of order 1 (F version) in the following augmented Dickey Fuller equation: $\Delta y_t = \alpha + \beta_t + \gamma Y_{t-1} + \lambda \Delta Y_{t-1} + \varepsilon_t$. It can be seen from the LM values that one period lag is enough to remove serial correlation in all situations. 3. NA= Not Applicable (as the variables have become stationary at the previous level of differencing) 4. Integrated of order one. 8. Critical values for ADF tests, for our case [see Hamilton (1994)], are around –2.96 for Dickey Fuller without trend and -3.57 for Dickey Fuller with trend.

Table 10: Test for Cointegration of AIIT Series[1]

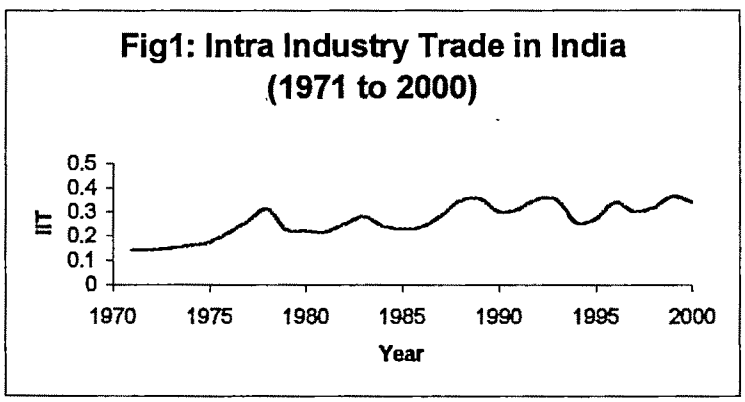
Maximum eigen value		Cointegrating vector(s)			
k = 0	k ≤ 1	AGNP	AMANU	ATARF	AKL
17.7*[2]	6.8*	0.0033			
		0.0001			
19.8*	4.6*		-0.024		
			0.01		
12.05	0.93			None	
23.16*	0.7				0.524

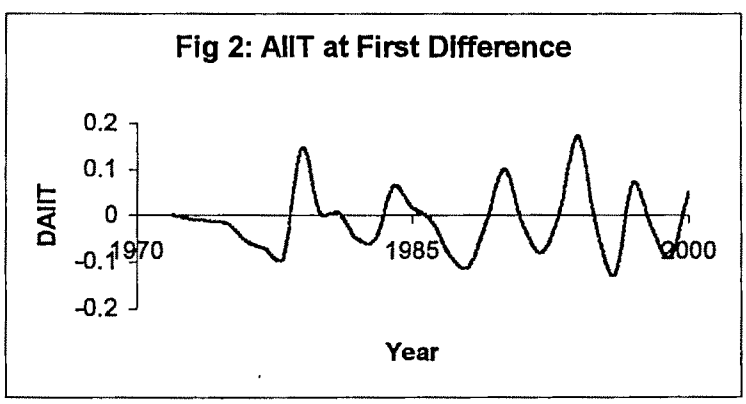
Notes: 1. Five lagged differences used. 2. '*' implies that null hypothesis is rejected at 95% level 3. Normalized coefficients. 4. There are two cointegration vectors for MANU and GNP, one for KL and none for TARF.

Table 11: Error Correction Coefficients for Granger Causality

Variable	From y_t to x_t			From x_t to y_t		
	λ_1^{1}	θ_1^{2}	η_1^{3}	λ_1^{1}	θ_1^{2}	η_1^{3}
y_t = AGNP	0.25	0.22	0.26	-0.76	-0.62	-0.72
	(3.56*)	(2.31*)	(2.05*)	(-3.34*)	(-2.22*)	(-2.18*)
y_t = AMANU	0.1	0.08	0.09	-0.66	-0.51	-0.62
	(2.61*)	(1.73**)	(1.65**)	(-3.31*)	(-2.18*)	(-2.25*)
y_t = AKL	0.03	-0.03	-0.12	-0.43	-0.32	-0.27
	-0.96	(-1.13)	(-2.86*)	(-2.47*)	(-1.66**)	(-1.12)

Notes: 1. One period lag. 2. Two period lag. 3. Three period lag. Figures in brackets are t-values.





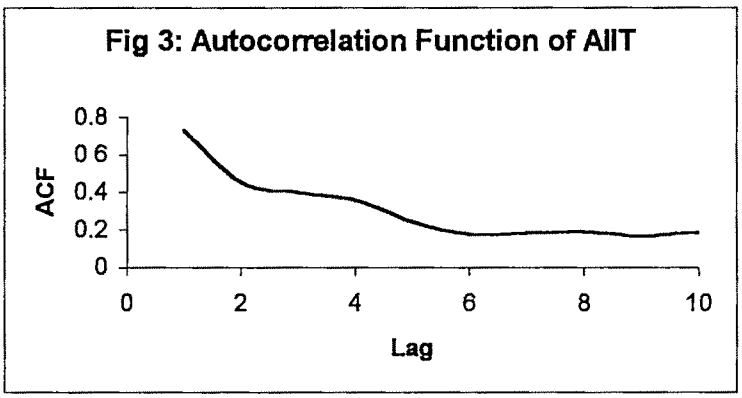


Fig 3: Autocorrelation Function of AIIT
ACF
0.8
0 6
0.4
0.2
0
0
2
4
6
8
10
Lag

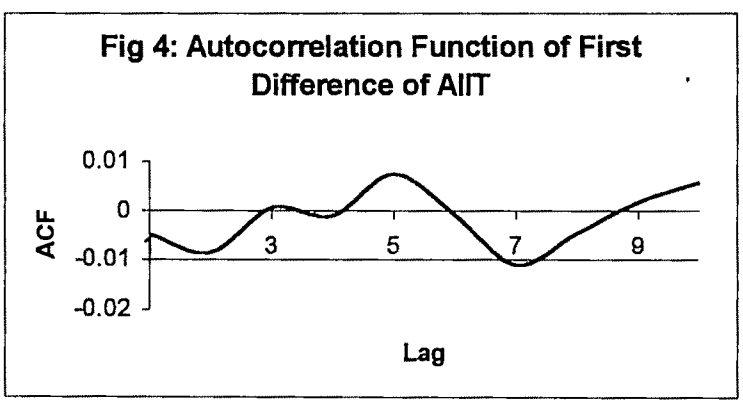


Fig 4: Autocorrelation Function of First Difference of AIIT
ACF
0.01
0
-0.01
-0.02
3
5
7
9
Lag

Appendix

Table A1: Country wise Breakup of Industries with High Bilateral IIT of India

COUNTRY	SITC	COMMODITY	GLU
USA	635	Wood manufactures, nes	0 998875
UK	665	Glassware	0.993662
THAILAND	681	Silver, platinum, etc.	0 986595
GERMANY	694	Nails, screws, nuts, etc	0 985507
FINLAND	652	Cotton fabrics, woven	0.985281
KOREA REPUBLIC	699	Manufacts. base metal, nes	0.981935
ITALY	694	Nails, screws, nuts, etc.	0.9568
SINGAPORE	675	Flat-rolled, alloy steel	0.954635
MALAYSIA	625	Rubber tyres, tubes, etc.	0 950495
GERMANY	676	Iron, steel bar, shapes etc.	0 949971
EGYPT	659	Floor coverings, etc.	0 948863
AUSTRIA	695	Tools	0.945205
JAPAN	699	Manufacts. base metal, nes	0 943404
AUSTRALIA	665	Glassware	0.931116
HONG KONG	699	Manufacts. base metal, nes	0.923908
SINGAPORE	629	Articles of rubber, nes	0.918556
ITALY	695	Tools	0 914435
DENMARK	699	Manufacts. base metal, nes	0.906976
HUNGARY	695	Tools	0.90663
CANADA	676	Iron, steel bar, shapes etc.	0.906422
AUSTRALIA	663	Mineral manufactures, nes	0.888059
GERMANY	621	Materials of rubber	0 884233
CANADA	679	Tubes, pipes etc. iron, steel	0 878291
GERMANY	681	Silver, platinum, etc.	0.878048
AUSTRALIA	679	Tubes, pipes etc. iron, steel	0 864269
SWITZERLAND	694	Nails, screws, nuts, etc.	0.862015
UK	672	Ingots etc. iron or steel	0.86166
KOREA REPUBLIC	652	Cotton fabrics, woven	0.859787
THAILAND	652	Cotton fabrics, woven	0.85884
SAUDI ARABIA	673	Flat-rolled, iron etc.	0 854838
QATAR	684	Aluminium	0.853717
SWITZERLAND	675	Flat-rolled, alloy steel	0 851851
NETHERLANDS	694	Nails, screws, nuts, etc.	0 848484
UK	678	Wire of iron or steel	0.84659
SINGAPORE	687	Tin	0.84423
HONG KONG	641	Paper & paperboard	0.841638
ITALY	693	Wire products excl. elect	0 833957
THAILAND	611	Leather	0 831683
USA	684	Aluminium	0.830227
UK	684	Aluminium	0.823008
GERMANY	665	Glassware	0.816034
HUNGARY	611	Leather	0.801104
USA	611	Leather	0.790994
FRANCE	625	Rubber tyres, tubes, etc.	0.789743
KOREA REPUBLIC	695	Tools	0.787906

COUNTRY	SITC	COMMODITY	GLU
USA	695	Tools	0.784693
JAPAN	651	Textile yarn	0.783114
FINLAND	675	Flat-rolled, alloy steel	0.781799
KOREA REPUBLIC	651	Textile yarn	0.775761
ITALY	625	Rubber tyres, tubes, etc.	0.766423
SINGAPORE	692	Containers, storage, transp	0 765613
ISRAEL	695	Tools	0.763948
UK	693	Wire products excl. elect.	0.761187
ITALY	699	Manufacts. base metal, nes	0.751586
CYPRUS	652	Cotton fabrics, woven	0.740331
ITALY	692	Containers, storage, transp.	0.738738
NETHERLANDS	699	Manufacts. base metal, nes	0.730098
SINGAPORE	673	Flat-rolled, iron etc.	0.726495
SPAIN	625	Rubber tyres, tubes, etc.	0.72544
AUSTRALIA	662	Clay, refect. constr. matrl	0.720779
INDONESIA	676	Iron, steel bar, shapes etc.	0.712933
ICELAND	652	Cotton fabrics, woven	0.696542
JAPAN	676	Iron, steel bar, shapes etc.	0.691146
ITALY	675	Flat-rolled, alloy steel	0.679197
ZAMBIA	699	Manufacts base metal, nes	0.66419
FRANCE	699	Manufacts. base metal, nes	0.659016
THAILAND	658	Textile articles nes	0.657754
SWEDEN	693	Wire products excl. elect	0.657575
USA	663	Mineral manufactures, nes	0.652889
SWITZERLAND	663	Mineral manufactures, nes	0.649563
BRAZIL	611	Leather	0.645082
UK	695	Tools	0.641984
ITALY	662	Clay, refect constr. matrl.	0.640483
MALAYSIA	629	Articles of rubber, nes	0.638509
ITALY	665	Glassware	0.637826
HONG KONG	612	Manufact. leather etc. nes	0.618226
AUSTRIA	665	Glassware	0.611012
SINGAPORE	695	Tools	0.607632
NETHERLANDS	665	Glassware	0.60406
USA	629	Articles of rubber, nes	0.594485
INDONESIA	652	Cotton fabrics, woven	0.592592
MALAYSIA	663	Mineral manufactures, nes	0.58644
AUSTRALIA	641	Paper & paperboard	0.574394
GERMANY	693	Wire products excl. elect	0.566113
CHINA	678	Wire of iron or steel	0.549177
SRILANKA	692	Containers, storage, transp.	0 541322
JAPAN	692	Containers, storage, transp.	0.535211
NETHERLANDS	679	Tubes, pipes, etc iron, steel	0.53145
DENMARK	695	Tools	0.522151
MALAYSIA	681	Silver, platinum, etc.	0.51335

Arthaniti 3 (1-2), 49-65 / 2004

Manufacturing Sector Productivity in India across phases of Liberalisation during 1981-97 : A Study of Selected States

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Abstract

This paper explores the relationship between different policy regimes and manufacturing sector productivity growth in four traditionally industrially developed states in India, namely West Bengal, Maharashtra, Tamil Nadu and Uttar Pradesh during the period 1981-82 to 1997-98. First, strong liberalisation (1991-92 to 1997-98) seemingly, has had a remarkable impact on growth of productivity of capital in West Bengal, but not in the other states. The study favours the premise that the strong liberalisation programme of 1991 (first wave of globalisation in India) has resulted in growth of labour in excess of capital, leading to a sharp fall in capital-intensity of growth Second, TFPG (using Tornqvist Index) shows a rising trend in all states only during the post-1991 period. During 1981-91, TFPG is declining in all states except West Bengal, where it is continuously rising. But the absolute TFPG figures are indicative of poor industrial performance. Third, technical progress has consistently been labour-intensive in nature (though statistically insignificant) in all states during the phase of strong liberalisation For the entire 17-year period West Bengal and U.P. have experienced capital-intensive technical progress while the reverse is true for Maharashtra and Tamil Nadu

JEL Classification : C23, C51, L60

Keywords : weak liberalisation, strong liberalisation, divisia index, labour-productivity, capital-intensity, wage-share, and total factor productivity growth (TFPG)

1. Introduction

Growth of factor productivity (partial and total) has conventionally been recognised as the principal determinant of economic growth. Consequently, for growth oriented industrial strategies, productivity growth has always had a key role. However, the growth rate of manufacturing sector productivity is likely to change with changes in policy regimes.

The New Economic Policy of 1991 saw some fundamental changes resulting in severe deregulation and de-control over manufacturing industries. The sole objective of these highly liberalised policies was to raise productivity and efficiency levels in Indian manufacturing by creating a competitive environment. Opening up of the domestic market resulted in (at the end of the protectionist regime in India) exposing domestic manufacturers to international competition. Needless to remind, the strong

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liberalisation policy of 1991 was biased heavily towards industries similar to those in the newly developed South East Asian countries.

We do not expect the different phases of liberalisation (or different policy regimes for that matter) to have the same impact on different regions or states with respect to factor productivity in manufacturing industries. The productivity growth patterns of different states are likely to differ according to the nature and extent of industrialisation in these states. In fact, industrialisation alone carries with it the potential of creating regional imbalances.

Throughout the latter half of the 20th Century, all South East Asian countries have been trying to accelerate the pace of industrialization. China took up the 'Go Global' slogan (model) long before India also fell in the line and was able to industrialize faster. China's principal growth strategy is based on export-oriented industrialization just like that in the other south East Asian nations (Dreze and Sen, 1995; Sachs, Varshney and Bajpai, 1999).

To the policy makers of these nations, industrialization has been synonymous with economic growth and development. According to Myrdal (1958), such a stride towards rapid industrialisation is bound to create regional imbalances especially in the early phases of development. Generally, industrial concentration hovers around few selected areas, which are geographically as well as economically viable. India is no exception in this regard. It is understood (observed as well) that the fruits of industrialisation (of economic growth as well) are not shared equally by all regions on account of inequalities in access to economic, political and social opportunities.

In Colonial India, the British paid attention to the economic development of those regions, exploiting which, they could satisfy their own economic objectives. Historically, pure economic objectives of the British moulded the development of port towns like Kolkata (Calcutta), Mumbai (Bombay) and Chennai (Madras). These centers served as the nuclei for the development of West Bengal, Maharashtra and Tamil Nadu respectively. Even post-independence era saw tremendous regional imbalances in industrialisation and growth – industrial belts tending to concentrate around metropolitan centers. The Hooghly and Howrah industrial belts are typical examples for West Bengal, so is the Kanpur belt for Uttar Pradesh (U.P.). U.P. of course now has a modern export enclave in the form of the Noida Industrial Export Processing Zone.

There have been a number of studies on spatial and temporal variations in the rate of Total Factor Productivity Growth (TFPG) in Indian manufacturing since 1951. While some of these studies have focused on selected industry groups over time, others have considered the entire manufacturing sector at the state level for examining inter-state and inter-temporal variations in TFPG. We briefly look at three influential

works in this area. Goldar and Seth (1989) studied trends in industrial output in 12 major states during the period 1960-61 to 1985-86. The purpose of their study however was to investigate the causes of industrial deceleration since mid-sixties. Pradhan and Barik (1998) observed trends in TFPG over a longer period ranging from 1963-64 to 1992-93 in selected polluting industries. Their study reveals a positive trend of TFPG with a marked deceleration in the 1980s. An important finding of their exercise was that TFPG in Indian manufacturing followed a fluctuating path. Neogi and Ghosh (1998) studied the impact of liberalisation on the performance of selected industries on the basis of firm level data over the period 1989 to 1994. They concluded that productivity growth and efficiency levels did not improve in these industries to the expectation level during the studied post-liberalisation period.

The present study is intended to search for regional inequalities in manufacturing sector productivity during the three distinct phases of liberalisation since 1981 across four traditionally industrially developed states – West Bengal, Tamil Nadu, Maharashtra and Uttar Pradesh (U.P.), representing respectively, the east, the south, the west and the north. Traditionally, U.P. is also an agriculturally developed state. But by contrast, U.P. is more industrialised compared to the other North Indian states (by absolute number of registered factories, volume of output, value added, employment, etc). U.P. hence has been chosen for the present study. We do not try to contrast manufacturing sector productivity between industrialized and non-industrialized states in this paper.

This paper, in particular, examines the nature of changes in productivity growth in Indian industries across different policy regimes during the period 1981-82 to 1997-98 in the four selected states. The periods 1981-82 to 1984-85 and 1985-86 to 1990-91 are considered as two phases (regimes) of weak liberalisation (Regime-1 and Regime-2 respectively) and the rest of the time span (1991-92 to 1997-98), Regime-3, as the phase of strong liberalisation (Dutt, 1993). We first consider the trends in the growth of average productivity of labour, capital and total factor productivity for Regime 1, Regime 2 and Regime 3 and also for the entire 17- year period. The growth of capital intensity (capital-labour ratio) and the capital-employee ratio are also studied across regimes. Like most Indian researches in this field, we consider value-added as a suitable substitute for output. The growth of total factor productivity (TFPG) is computed under Tornqvist index of growth accounting process. Value added, labour and fixed capital are the three variables used to compute the TFPG time series. Finally, we look at the type of technical progress experienced by the manufacturing sector in each of the four states. That is, we check whether technical progress is of capital-saving type or it's contrary.

Section 2 describes models, methodology of estimation along with data sources. In section 3, we present empirical results along with brief discussions and in section 4, summary and conclusions.

2. Methodology and Data Base

Following Poirier's (1974) spline function approach, the trend in the growth of several variables of interest is looked into for different regimes. Assuming a linear time trend, the postulated model is

$$\left.\begin{array}{ll} \text{Regime 1:} & \ln Y_t = \alpha_1 + \beta_1 t + u_t \quad \text{for } t \le 1985 \\ \text{Regime 2:} & \ln Y_t = \alpha_2 + \beta_2 t + u_t \quad \text{for } 1986 < t \le 1991 \\ \text{Regime 3:} & \ln Y_t = \alpha_3 + \beta_3 t + u_t \quad \text{for } 1991 < t \end{array}\right\} \tag{3.1}$$

Let us define the following variables:

$$w_{1t} = t;\ w_{2t} = \begin{cases} 0 & \text{if } t \le 1985 \\ t - 1985 & \text{if } 1985 < t \end{cases}\ w_{3t} = \begin{cases} 0 & \text{if } t \le 1991 \\ t - 1991 & \text{if } 1991 < t \end{cases} \tag{3.1a}$$

and reparameterise the function as

$$\ln Y_t = \alpha_1 + \delta_1 w_{1t} + \delta_2 w_{2t} + \delta_3 w_{3t} + u_t \tag{3.2}$$

The expression $[\exp(\beta_i) - 1] * 100$ will yield the percentage growth rate for the i-th regime (i = 1,2,3), where $\beta_1 = \delta_1$, $\beta_2 = \delta_1 + \delta_2$ and $\beta_3 = \delta_1 + \delta_2 + \delta_3$. Equation (3.2) will be used to compute the growth rates of desired variables in the four states for different regimes. The variables, which capture the growth rates in the three different regimes, are w_{1t}, w_{2t} and w_{3t} respectively. The growth rate for the entire period 1980-81 to 1997-98 will be computed by using the equation as

$$\ln Y_t = \alpha + \beta t + u_t \tag{3.3}$$

The variables we shall consider are listed below.

APL: Average productivity of labour; APE: Average productivity of employee, APK: Average productivity of capital; APMS: Average productivity of managerial staff; CAPINL: Capital intensity when capital is considered per unit of labour only; CAPINE: Capital intensity when capital is considered per unit of employee; TFPG: Total factor productivity growth.

In order to compute the growth of total factor productivity, we shall use Tornqvist Index of TFPG. Tornqvist index is an important variant of the divisia index used by Solow. Under the specification of a translog production function under constant returns to scale, Diewart (1976) proved that the Tornqvist index is the exact measure of technical change. Thus, if there is a transcendental logarithmic production function as

$$\ln Y_t = \alpha_0 + \alpha_t t + \beta_{tt} t^2 + \sum_{i=1}^{k} \alpha_i \ln X_i + \frac{1}{2} \sum_i \sum_j \beta_{ij} \ln X_i \ln X_j + \sum_{i=1}^{k} \beta_{it} t \ln X_i + u_t \tag{3.4}$$

Tornqvist approximation of the divisia index, as introduced by Jorgensen and Grilliches (1967), can be written as

$$\overline{DI}_t = \ln\left(\frac{Y_t}{Y_{t-1}}\right) - \sum_{i=1}^{k} \overline{Sh}_i \ln\left(\frac{X_{i,t}}{X_{i,t-1}}\right) \tag{3.5}$$

where $\overline{Sh}_i = \frac{1}{2}\left[Sh_{i,t} + Sh_{i,t-1}\right]$. The average rate of technical change, $\overline{DI}_t$, is also called translog index of technical change.

It should be noted that the translog measure of the total factor productivity growth is not significantly different from the Solow residual measure under two conditions. First, the elasticity of substitution is not significantly different from 1. Second, variation in the growth rates of inputs over time is not significant (see, Ahluwalia 1991). Using equation (3.5), we shall compute the growth of total factor productivity.

Total factor productivity and the rate of technical progress are synonymous. The higher the rate of technical progress, the higher will be the growth of output. Hence, the estimation of the rate of technical progress and its input bias is relevant. Under the specification of production function as in (3.4), the expression for the rate of technical progress (or TFPG) is given as

$$\frac{\partial \ln Y}{\partial t} = \alpha_t + \beta_{tt} t + \sum_i \beta_{it} \ln X_i \tag{3.6}$$

where α_t stands for the rate of autonomous growth of total factor productivity, β_{it} for the bias in the growth of total factor productivity and β_{tt} for the rate of change in the growth of total factor productivity. If $\beta_{it} = 0$, technical progress is Hicks neutral. If $\beta_{it} > 0$, technical progress is non-neutral in the Hicksian sense and is biased with respect to the *i*th input.

Assuming a transcendental logarithmic production function as (3.4), output elasticity with respect to i-th endogenous input is

$$\eta_i = \frac{\partial \ln Y_t}{\partial \ln X_i} = \alpha_i + \sum_j \beta_{ij} \ln X_j + \beta_{it} t \tag{3.7}$$

Differentiating (3.7) with respect to t yields, $\frac{\partial \eta_i}{\partial t} = \beta_{it}$

Thus, technical progress may increase or decrease the value of output elasticity with respect to

i-th endogenous input depending on the sign of β_{it}. The rate of technical progress is defined in (3.6). Under the strong assumptions that competitive equilibrium prevails and factor prices are paid according to their marginal products, we have

$$\eta_i = \frac{\partial \ln y}{\partial \ln X_i} = \frac{\partial y}{\partial X_i}\frac{X_i}{y} = \frac{w_i X_i}{py} = sh_i$$

where sh_i is the share of the i-th input in nominal output (value-added in this study). Hence,

$$\frac{\partial \eta_i}{\partial t} = \frac{\partial (sh_i)}{\partial t} = \beta_{it},$$

We can also write,

$$X_i = sh_i \frac{py}{w_i}$$

$$\text{or, } \ln X_i = \ln sh_i + \ln p + \ln y - \ln w_i$$

Differentiating this expression with respect to t we have,

$$\frac{\partial \ln X_i}{\partial t} = \frac{\partial \ln sh_i}{\partial t} + \frac{\partial \ln y}{\partial t} = \frac{1}{sh_i}\frac{\partial (sh_i)}{\partial t} + RTP = \frac{1}{sh_i}\frac{\partial \eta_i}{\partial t} + RTP = \frac{1}{sh_i}\beta_{it} + RTP$$

This gives the amount of bias in technical progress.

$$BIAS_t(X) = \frac{1}{sh_i}\beta_{it} + RTP \qquad (3.8)$$

For empirical estimation, we have used *Annual Survey of Industries* (ASI) data for the entire manufacturing sector of each of the selected four states for a period of 17 years (1981-82 to 1997-98). Nominal values of all variables were deflated by appropriate wholesale price indices from RBI. *Report on Currency and Finance* (various issues). The price indices of machinery and equipment were used to deflate fixed capital stock at current prices. We measure labour by the number of workers engaged in production as also by the number of employees.

Admittedly, there is no satisfactory or universally accepted way of measuring capital stock (Ahluwalia, 1991). Since measurement of true economic depreciation is a very complex exercise, we choose to work with estimates of gross fixed capital stock.

Here we have computed gross fixed capital stock at constant prices by using the perpetual inventory accumulation (PIA) method (Goldsmith, 1951). As regards the gross fixed capital stock at replacement cost for the benchmark year (1980-81), we have used the rule of thumb after Roychaudhury (1977), "doubling the value of fixed

capital stock at book value at current prices for the benchmark year", to estimate the replacement cost figures of machinery and equipment. All throughout the study, the term 'labour' is used to mean 'workers directly engaged in production' or simply 'production workers'.

3. Empirical Results

Refer to Table 1A. In West Bengal, both labour and employee have registered negative growth rates except in regime 3. Strong liberalisation has raised labour growth. Note that it was growing negatively during the entire pre-1991 period. Managerial staff shows the same pattern with an overall negative growth. But capital has always grown positively. Considering the entire 17-year period, there is a huge mismatch between growth rates of labour and capital – inclined heavily towards the latter. A noteworthy observation: strong liberalisation has tremendously raised output growth, which was negligible both in regimes 1 and 2. But it is surprising that growth of capital has fallen steadily across regimes and is lowest during the phase of strong liberalization. Regarding structural shifts in growth pattern, output experienced a highly significant upward shift in Regime 3. Labour, employee and managerial staff all exhibit a declining trend throughout regimes 1 and 2, reversed only in Regime 3. Capital, which went through a significant rising trend in Regime 1, suffered successive downward shifts (in terms of growth rate) during regimes 2 and 3 (shift parameter was insignificant in Regime 3).

Moving on to U.P., output showed consistently significant growth rates, rising across regimes. It grew fastest during Regime 3. This is in line with the observation made for West Bengal in respect to output growth. After growing negatively in Regime 1, labour and employee grew positively in Regime 3, making a turn around similar to that observed in West Bengal. However, the managerial staff has been growing positively through all regimes. Growth rate of capital declined steadily across regimes, similar to that observed in West Bengal. Labour and employee registered negligible growth during the entire study period. Output and capital showed significant upward structural shifts in Regime 1, though the latter suffered downward shifts in regimes 2 and 3.

Maharashtra displays an output growth pattern very similar to West Bengal, but labour and employee experienced an overall positive growth (cf. negative in West Bengal). After growing negatively in regimes 1 and 2, both labour and employee grew by more than 3 percent per annum in Regime 3. Capital growth fluctuated around the 11 percent mark, reaching a peak (12.50 percent per annum) in Regime 3. This observation of a steadily growing capital stock in Maharashtra is in sharp contrast to that observed in West Bengal and U.P. Output, labour and employee showed significantly positive structural shifts in Regime 3. But capital experienced such a shift only in Regime 1.

In Tamil Nadu, output growth dropped significantly in Regime 3, in sharp contrast to the pattern seen in the other states. Moreover labour, employee and managerial staff all grew positively throughout, registering an over all 3 percent growth (unobserved in other states). Labour and employee grew fastest during Regime 3. Capital growth has been very steady (around 12 percent), similar to that in Maharashtra.

Refer to Table 1B. Growth of average product of labour (employee) has been fastest in Regime-3 both for West Bengal and U.P., though exactly the reverse is seen in case of Maharashtra and Tamil Nadu. Average product of managerial staff registered a declining growth in Tamil Nadu during Regime 3 compared to other regimes, but not so in Maharashtra. On account of the contrasting observations we cannot say that strong liberalisation has raised labour productivity.

After growing negatively during the first two regimes, average product of capital in West Bengal registered positive growth in Regime 3, although it has grown negatively over the entire period. Almost similar has been the experiences in Maharashtra and Tamil Nadu where capital productivity has been growing negatively throughout all regimes. Growth rate of capital intensity with respect to labour has been falling across regimes in all the four states – the growth rate being lowest in Regime 3. The picture is no different for capital-intensity considering employee instead of labour.

Tornqvist index of TFPG (found negative in all states except West Bengal) shows that efficiency level of the manufacturing sector taken as a whole is poor in each of the four states. Even then, leaving out U.P. (where TFPG was declining in Regime-1), there is a hint of improvement in TFPG in Regime 3. Total factor productivity growth in the manufacturing sector is meager at the state level but not necessarily so at the industry level (Adhikary, *et al*, 2003). TFPG was declining throughout regimes 1 and 2 (i.e. over the period 1981-91) in Maharashtra and Tamil Nadu. The trend was reversed in the post-1991 period in these two states. Ahluwalia (1991) computed TFPG for each of the major industry groups at the 2-digit (national) level for the period 1959-60 to 1985-86 and classified industries under high, moderate and low rate of TFPG. Her study reveals negative TFPG for industries as iron and steel, food processing, paper, non-ferrous metals, explosives, tyres and tubes, and petroleum and coal products over the 16-year period. Thus negative TFPG is something common in Indian manufacturing.

The regression estimates of equation (3.6) are presented in Table 2. With reference to Table 2, rate of technical progress appears declining, insignificant though statistically, in all states except in Maharashtra. Since both labour and capital coefficients are insignificant, we do not comment on the nature of bias in technical progress. We simply interpret it as neutral in our present study on account of insignificant capital and labour coefficients.

4. Summary and Conclusions

This paper observes the pattern of manufacturing sector productivity growth in selected Indian states, namely West Bengal, Maharashtra, Tamil Nadu and Uttar Pradesh during the three distinct phases of liberalisation during 1981-97. More specifically, the nature of changes in productivity growth in manufacturing industries of the selected states is observed across different policy regimes during the period 1981-82 to 1997-98. The periods 1981-82 to 1984-85 and 1985-86 to 1990-91 are considered as the two phases (regimes) of weak liberalisation (Regime-1 and Regime-2 respectively) and the rest of the time span (1991-92 to 1997-98), Regime- 3, as the phase of strong liberalisation (Dutt, 1993). Gross value-added is taken as a proxy for output in value terms. The growth of total factor productivity (TFPG) is computed under Tornqvist index of growth accounting process. Finally, we verify whether technical progress is of capital-saving type or its converse.

In sum strong liberalisation appears to have a positive impact on growth of output in the manufacturing sector in all states except Tamil Nadu. Moreover, post – 1991 (Regime-3) growth rates of labour and employee are clearly higher in all states. Employment in the manufacturing sector has been declining throughout the period 1981-91 in West Bengal, U.P. and Maharashtra but not in Tamil Nadu. Strong liberalisation has undoubtedly reversed this trend. Growth rate of fixed capital has fallen in Regime 3 in all states except Maharashtra. Liberalisation was expected to raise capital growth relative to labour growth by promoting automation. Our observations however contradict this.

Second, growth rate of productivity of capital is highest during the period of strong liberalization only in West Bengal – not in the other states. For other states growth rate of productivity of capital is lower in the post – 1991 period. Apparently strong liberalisation has raised the growth rates of productivities of labour and employee in West Bengal and U.P. but not in the other states. Output growth in excess of growth of labour force in West Bengal and U.P. (during Regime-3) has been responsible for this contrast.

Growth rate of capital-intensity has significantly declined during post-liberalisation era in all states. This is also evident from the growth figures of capital and labour. We have measured capital-intensity in an aggregative sense. That is, it does not consider the firm wise distribution of capital-intensities. A possible explanation of declining capital-intensity growth runs in the following lines. To register a decline in capital-intensity growth it is not necessary that the techniques of production in the already established units be more labour absorbing or more capital saving than before (during the post-1991 period). It could well be that with liberalisation the more labour intensive sectors are dominating. As a result the newly installed units (possibly more

labour absorbing than those installed during the pre-1991 years) have added more to total number of labourers than to total capital stock leading to a sharp fall in capital-labour ratio. To confirm this view we would need to observe the frequency distribution of firms according to capital-labour ratios both for pre-1991 and post-1991 years. Our hypothesis is supported if we find greater concentration of firms around a higher mean capital-output ratio during pre-liberalisation years vis-à-vis greater concentration of firms around a lower mean capital-labour ratio during post-liberalisation years. This however requires a separate firm level analysis, beyond the scope of the present undertaking.

Growth of TFPG is poor in all four states. Moreover TFPG shows a declining trend Regime-1 in U.P. TFPG has a falling trend even in Maharashtra and Tamil Nadu throughout regimes 1 and 2. Strong liberalisation has apparently raised TFPG growth in these two states. If TFPG is taken as a measure of performance and efficiency, then strong liberalisation has benefited the manufacturing sector in all states except U.P.

Third, regarding technical progress we cannot make any comment with conviction on the direction of bias since both labour and capital coefficients are statistically insignificant. It appears that, strong liberalisation has raised labour intensity growth hinting at a bias toward labour-intensive technical progress. This can challenge the claim that strong liberalisation will displace labour for capital in the manufacturing sector in general. It is also clear from the growth figures of labour and capital – the observation being that strong liberalisation invariably reduced capital growth but raised labour growth. Even if there have been closures of units (during post-1991), the employment loss has actually been over compensated resulting in a rise in the absolute level of employment. Consequently, the declining trend of employment in the manufacturing sector observed during the pre-1991 years has been reversed.

Labour growth is significantly positive only during the post-1991 period in West Bengal. A possible explanation runs in terms of utilisation of excess capacity during Regime-3. In all probability, strong liberalisation has tremendously boosted demand for industrial output (apparent from the high output growth figures in West Bengal during Regime-3). This has necessitated employment absorption (in excess of capital goods) just to make use of the unutilised installed capacity. Furthermore, it explains decline in growth rate of capital stock along side a rise in employment growth rate in Regime-3. Strong liberalisation has invariably raised employment growth in all states. For West Bengal, the establishment and full functioning of the Haldia Petrochemical Project along with its ancillary industries during Regime 3, may as well explain the declining growth rate of capital intensity. In addition, the dairy giant Mother Dairy Calcutta was taken over by the West Bengal State Government after 1992-93. This effected in a sharp rise in total employment in the dairy industry (broadly categorised under food-processing industries by ASI). The apprehension that strong

liberalisation will ultimately result in absolute decline in employment levels in the manufacturing sector (by displacing labour) seems unfounded in each of the four states.

A final remark: The study favours the premise that the strong liberalisation programme of 1991 (first wave of globalisation in India) has resulted in growth of labour in excess of capital leading to a sharp fall in capital-intensity growth in West Bengal and U.P. Even technical progress during the period of strong liberalisation is biased in favour of labour, though statistically insignificant. But on the basis of this aggregative study based on the four states alone, it would be inappropriate to draw any credible conclusion involving the Indian economy at large. Finally, growth of TFPG is poor in all the four states. West Bengal is the only state where TFPG (found positive) exhibits a continuously rising trend. Interestingly, TFPG growth is significantly higher during the post-1991 period in all states with the exception of U.P.

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Table 1A. Structural Shifts and Growth Rates of Value Added, Labour, Employee and Capital in Selected States of India (Calculated t values are presented in parenthesis in all Tables)

Dependent Variable	Constant	Coefficients for Regime 1	2	3	(R^2) $(\bar{R}^2)$	D.W.	Growth Rate for Regime 1	2	3	Entire Period
West Bengal										
Output	7.391 (150.12)**	0.015 (1.69)	0.002 (0.16)	0.073 (3.02) **	0.91 (0.89)	2.06	1.52	1.75	9.51	3 91
Labour	13.543 (391.67) **	-0.03 (-4.80) **	0.003 (0.33)	0.056 (3.28) **	0.76 (0.71)	2.08	-2.96	-2.64	2.96	-1.17
Employee	13.77 (399 56) **	-0.027 (-4 34) **	0.003 (0.28)	0.05 (2.92) *	0 73 (0.66)	1.79	-2 67	-2.40	2.56	-1.08
Managerial Staff	12.176 (306.81) **	-0 016 (-2 28) *	0.001 (0.06)	0.026 (1.35)	0.45 (0.32)	1.15	-1.62	-1.56	1.07	-0 77
Capital	8.291 (321.52) **	0.102 (21.83) **	-0.019 (-2 61) *	-0.013 (-1.03)	0.99 (0.99)	2.08	10 72	8 61	7.20	9.72
Uttar Pradesh										
Output	7.128 (85.99) **	0.078 (5.22) **	0.031 (1.31)	0 037 (0.91)	0.94 (0.93)	1.09	8.15	11.55	15.77	9 09
Labour	13.336 (421.96) **	-0.007 (-1.16)	0.009 (0.97)	0.018 (1 13)	0.8 (0.61)	1 69	-0.66	0.22	2.00	-0.07
Employee	13.525 (418.28) **	-0.001 (-0.09)	0 007 (0 76)	0 013 (0.8)	0.53 (0.43)	1.58	-0.05	0.65	1.94	0.38
Managerial Staff	11.783 (319.18) **	0.023 (3.44) **	0 001 (0.07)	-0 007 (-0.37)	0.81 (0.77)	1.34	2.32	2.40	1.71	2.08
Capital	8.723 (643.35) **	0.104 (42.39) **	-0.01 (-2 51) *	-0.015 (-2.27) *	1.00 (1.00)	2.05	10.96	9.88	8.23	9.88
Maharashtra										
Output	7.301 (149.92) **	0.01 (1.60)	0.001 (0.14)	0.07 (3.00) **	0 94 (0.89)	2.06	8.16	6.10	7.06	6 93
Labour	13.757 (683.63) **	-0.006 (-1.71)	-0.001 (-0.16)	0.04 (3.75) **	0.79 (0.75)	2.12	-0 62	-0.72	3.05	0.59
Employee	14.062 (650.26) **	-0.005 (-1.16)	-0.002 (-0.32)	0.04 (3.71) **	0.83 (0 79)	2.09	-0.45	-0.65	3.36	0.83
Managerial Staff	12.724 (470.56) **	0.0001 (0.02)	-0.005 (-0 60)	0.05 (3.38) **	0 87 (0 84)	2.09	0 01	-0.45	4.13	1.47
Capital	9.134 (717.62) **	0.107 (44.32) **	0.004 (1.14)	0.01 (1.85)	1.00 (1.00)	1.66	10.74	11.20	12.50	10.59
Tamil Nadu										
Dependent Variable	Constant	Coefficients for Regime 1	2	3	(R^2) $(\bar{R}^2)$	D.W.	Growth Rate for Regime 1	2	3	Entire Period
Output	7.327 (153.46) **	0.085 (9.89) **	-0.006 (-0.44)	-0.01 (-0.56)	0.98 (0.97)	1.65	8.92	8 26	6.84	8.10
Labour	13.338 (807.49) **	0.024 (7.95) **	-0.006 (-1.35)	0.02 (2.30) *	0.98 (0.97)	1.48	2.40	1.76	3.68	2.97
Employee	13.554 (775.03) **	0.025 (7.91) **	-0.007 (-1.39)	0.02 (1.83)	0.98 (0.97)	1.54	2.53	1.82	3.45	3.01
Managerial Staff	11.919 (451.63) **	0.03 (6.29) **	-0.009 (-1.23)	0 (0.34)	0.95 (0.94)	1.93	3.05	2.10	2.56	3.13
Capital	8.232 (464.11) **	0.123 (38.48) **	0.006 (1.16)	-0.01 (-1 44)	1.00 (1.00)	1.44	13.14	13.81	12.38	11.94

* Significant at 5 percent level.

** Significant at 1 percent level.

Table 1B. Structural Shifts and Growth Rates of Factor Productivities, Capital Intensity, and TFPG in Selected States of India.

Dependent Variable	Constant	Coefficients for Regime 1	2	3	(R^2) $(\overline{R}^2)$	D.W	Growth Rate for Regime 1	2	3	Entire Period
West Bengal										
APL	-6 152	0.045	-0 001	0.018	0.92	2 24	4 62	4.51	6 36	5.08
	(-108.72) **	(4.41) **	(-0.06)	(0.63)	(0.90)					
APE	-6.379	0.042	-0 001	0.024	0 92	2 17	4.31	4.20	6.72	5.00
	(-113 78) **	(4 16) **	(-0.03)	(0 86)	(0 90)					
APMS	-4.785	0.031	0.002	0.047	0.9	1.93	3.20	3.36	8.35	4.69
	(-82.451) **	(3.00) *	(0.09)	(1.64)	(0.88)					
APK	-0.9	-0.087	0.021	0.087	0.92	2.19	-8.30	-6.31	2 16	-5.81
	(-14.049) **	(-7.48) **	(1.17)	(2.74) *	(0.90)					
CAPINL	-5.252	0.132	-0.022	-0 069	0.99	2 41	14.09	11 55	4.12	10 89
	(-134.98) **	(18.73) **	(-2 03)	(-3 59) **	(0.99)					
CAPINE	-5.478	0.129	-0.022	-0 063	0.99	2 18	13 75	11 28	4.53	10.81
	(-140.56) **	(18.28) **	(-1.97)	(-3.26) **	(0.99)					
TFPG (To -rnqvist)	0 029	-0.007	0.008	0.044	0.56	2.85	0.03	0.03	0 44	0.02
	(0.31)	(-0.44)	(0.29)	(0.96)	(0.39)					
Uttar Pradesh										
APL	-6.398	0.079	0 024	0.024	0.96	1.37	8 20	10 83	13.56	8.72
	(-95 25) **	(6.49) **	(1.25)	(0.73)	(0.95)					
APE	-1.596	-0.026	0.041	0 052	0.5	1.13	-2 53	1 51	6.96	-0.79
	(-18.72) **	(-1 66)	(1.67)	(1.24)	(0 37)					
APMS	-4.656	0.055	0.03	0.044	0 94	1.52	5 689	8 93	13.82	7.02
	(-68.67) **	(4.51) **	(1.56)	(1 31)	(0.92)					
APK	-4.612	0 111	-0.018	-0.033	0.99	1.58	11.694	9.65	6.10	9.96
	(-122.96) **	(16.31) **	(-1.73)	(-1.77)	(0.99)					
CAPINL	-4 802	0.104	-0.017	-0.028	0.99	1.49	11.014	9.18	6.16	9.51
	(-127 51) **	(15.34) **	(-1.55)	(-1.51)	(0.99)					
CAPINE	1 966	0.01	0.004	0.004	0.94	1.11	1.021	1.429	1.83	1.15
	(180.10) **	(5.15) **	(1 29)	(0.72)	(0.92)					
TFPG (To -rnqvist	-0.122	0 035	-0.048	-0 115	0 327	2.37	-0 103	8 16	0.71	0.18
	(-1.28)	(2 05)	(-1 77)	(-2 48)	(0 17)					
Maharashtra										
APL	-5.612	0 084	-0 018	-0 03	0.98	1.97	8.78	6.82	4.01	7.52
	(-130.45) **	(10.82) **	(-1 48)	(-1.26)	(0.97)					
APE	-5.916	0.082	-0.017	-0.03	0.97	2.05	8.60	6.75	3 70	7.27
	(-135.42) **	(10.44) **	(-1 38)	(-1.35)	(0 97)					

Table 1B contd.					**Maharashtra**					
Dependent Variable		Coefficients for Regime					Growth Rate for Regime			
	Constant	1	2	3	(R^2) $(\bar{R}^2)$	D.W	1	2	3	Entire Period
APMS	-5.333	0 015	0 007	0.03	0.71	1 71	1.51	2.22	5.16	2.44
	(-90.82) **	(4.51) **	(0.41)	(0.98)	(0.64)					
APK	-0.988	-0.024	-0.018	0	0.76	1 94	-2.37	-4.16	-4.26	-2.48
	(-18.02) **	(-2.42) *	(-1.49)	(-0.04)	(0.70)					
CAPINL	-4.623	0.108	0.005	-0.03	0.99	2 25	11.43	12.00	9.16	10.00
	(-174 65) **	(22.61) **	(0.67)	(-1.97)	(0.99)					
CAPINE	-4.928	0.107	0.006	-0.03	0.99	2.18	11.24	11.92	8.83	9.75
	(-174.85) **	(20.90) **	(0 76)	(-2.01)	(0.99)					
TFPG (To	-0 075	0 029	-0.042	-0.136	0 473	2.40	-0.42	-0.87	0.39	0.07
-mqvist)	(-0.71)	(1.57)	(-1 39)	(-2.63) *	(0.35)					
Tamil Nadu										
APL	-6.011	0.062	0	-0.03	0.95	1.88	6.36	6.40	3.05	11.94
	(-138.34) **	(7.85) **	(0.03)	(-1.49)	(0.94)					
APE	-6.227	0.06	0.001	-0.03	0.95	1.85	6.23	6.33	3.28	5.10
	(-140.71) **	(7.55) **	(0.07)	(-1.33)	(0.94)					
APMS	-4.592	0.055	0.003	-0.02	0.93	1.81	5.70	6.04	4.18	4.97
	(-0.02)	(6.13) **	(0.22)	(0.22)	(0.92)					
APK	-0.905	-0.038	-0.012	0	0.9	1.67	-3.73	-4.87	-4.93	-3.84
	(-19.49) **	(-4.53) **	(-0.90)	(-0.03)	(0.88)					
CAPINL	-5.106	0 1	0.012	-0.03	0.99	1.02	10.48	11.84	8.40	-3.84
	(-201.17) **	(21 72) **	(1.69)	(-2.50) *	(0.99)					
CAPINE	-5.323	0 098	0.013	-0.03	0.99	0.99	10.34	11.77	8 64	8.94
	(-201.48) **	(20 60) **	(1.70)	(-2.18) *	(0.99)					
TFPG (To	-0.075	0.029	-0.042	-0.136	0.47	2.40	-0.42	-0.86	0.39	0.07
-mqvist)	(-0.71)	(1.56)	(-1.39)	(-2.63) *	(0.35)					

* Significant at 5 percent level.
** Significant at 1 percent level.

Table 2.

Regression Estimates of Rate of Technical Progress in Selected States of India.

	West Bengal									
	Coefficients of							Amount of Bias i		Nature of Technical Progress
Regime	Constant	Time	Capital	Labour	R^2	$(\bar{R}^2)$	D.W	Capital	Labour	
Regime 1	8.445	0.048	-0 742	0.16	0.53	0.46	2.85	-2.03	0 25	Neutral
1981-85	(0 25)	(0.09)	(-0.16)	(0.15)						
Regime 2	13.803	-0.268	3.076	-2.914	0.85	0.38	2 24	7.29	-5 01	Neutral
1986-90	(0.24)	(-1.91)	(2.22)	(-0.63)						
Regime 3	3.588	0.057	-0.352	0.065	0.67	0.57	2.94	-0.53	0.25	Neutral
1991-97	(0.22)	(0.59)	(-0.39)	(0 07)						
Entire Pd	-7.028	-0.065	0.75	0 058	0.49	0.38	2.34	1.67	0 17	Neutral
1981-97	(-1.19)	(-1.11)	(1.29)	(0.16)						
	Uttar Pradesh									
Regime 1	26.935	-0.27	2.481	-3.585	0.84	0 63	2.38	4.49	-8 06	Neutral
1981-85	(0 56)	(-0.56)	(0 57)	(-1.44)						
Regime 2	165.135	1.061	9.641	-6 039	0.51	0.40	2.62	14 64	-17.83	Neutral
1986-90	(0.96)	(0 92)	(-0.87)	(-0.99)						
Regime 3	-88 146	-0.203	-1.267	5.762	0.79	0 58	1.23	-1 65	25.00	Neutral
1991-97	(-2.34)	(-0.61)	(0.35)	(2.27)						
Entire Pd	-5.047	-0 225	2.243	-1.068	0.40	0 27	2 00	3.37	-3.24	Neutral
1981-97	(-0.18)	(-1 01)	(0 99)	(-0 95)						
	Maharashtra									
Regime 1	24.944	-0.042	0.036	-1.785	0.79	0.68	2.98	0.10	-4.24	Neutral
1981-85	(0 29)	(-0.09)	(0.01)	(-0.29)						
Regime 2	-63.62	0.875	-8.744	10.253	0.96	0.84	3 21	-13.59	28.64	Neutral
1986-90	(-0.85)	(3.99)	(-4.31)	(1 80)						
Regime 3	171.3	1.362	-12.457	4.128	0.73	0.46	1 94	-16.89	15.73	Neutral
1991-97	(0.86)	(0.83)	(-0.94)	(0.67)						
Entire Pd	55.476	0.413	-3.943	1 382	0.37	0.23	1 56	-5.94	4.10	Neutral
1981-97	(2.15)	(1.45)	(-1.46)	(1.49)						
	Tamil Nadu									
	Coefficients of							in		Nature of Technical Progress
Regime	Constant	Time	Capital	Labour	R^2	$(\bar{R}^2)$	D.W	Capital	Labour	
Regime 1	38 963	0.301	-2 351	-1.435	0.70	0.55	2.98	-3.86	-3.56	Neutral
1981-85	(1.07)	(0.41)	(-0.39)	(-0.63)						
Regime 2	-65.37	-0 014	-1.583	5.848	0.38	0.24	1 54	-2.33	17.12	Neutral
1986-90	(-0.48)	(-0 03)	(-0 41)	(0.57)						
Regime 3	-77.31	-0 329	0.126	5.781	0.90	0.81	2.84	0.17	21.65	Neutral
1991-97	(-2.89)	(-1.98)	(0.07)	(2.56)						
Entire Pd	-14 616	-0.207	1.583	0.127	0 33	0.17	1 19	2.40	0.44	Neutral
1981-97	(-0.62)	(-1.17)	(-1.46)	(0.11)						

Arthaniti 3 (1-2), 66-83 / 2004

The Prime Minister Rozgar Yojana (PMRY) Scheme: Recoveries
A Study of Select Districts in Andhra Pradesh

D.Chennappa*

Abstract
The Prime Minister Rozgar Yojana (PMRY) scheme introduced in India on October 2,1993 with the main objective of encouraging the educated unemployed youth to undertake self-employment ventures in Industry, Services and Business sectors with the provision of financial packages. This paper examines the repayment behavior of the PMRY beneficiaries. The repayment of the scheme is generally poor and not uniform in rural and urban areas, in category wise, family occupation wise, gender wise, educational qualifications wise classification as well as between the Industry, Services and Business sectors and reasons are explained for poor recoveries

JEL Classification :

Keywords :

1. Introduction

Indian economy has been facing challenges with regard to unemployment and economic growth. By and large, unemployment in India is structural in organised sector. During the past five decades, population of India has grown at an alarming rate of around 2.2 per cent per annum, whereas employment opportunities have not increased correspondingly due to slow economic growth. However, the removal of unemployment has been a proclaimed objective of Indian economic plans. The problem of unemployment is perceived to be conflicting with economic growth. Though with degrees of difference, every Five-Year Plan focused its attention on the removal of unemployment.

Employment generation to meet the backlog of the unemployed sections and new additions to the labour force are challenging tasks. The increasing diversification of the economy together with acceleration in economic growth causes structural changes in the nature of the job market. Higher economic growth in the recent past has been more capital intensive, and it may have resulted in low labour employment intensity. The pattern of economic growth in the capitalistic countries is causing an increase in poverty among the working population. The rapid technological orientation is widely regarded as a primary cause of unemployment.

Further, the most alarming form of unemployment today is educated unemployment. Its prevalence is omnipresent, because rural as well as urban sector is

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facing the drain in resources. The educated unemployed represents the intellectual section of the society and their frustration and discontent may result in political instability as well as an atmosphere of pessimism and loss of confidence in the government.

While the economic policies of the country continued to undergo changes in the form of shifting the focus from economic growth to employment or vice-versa in accordance with the changing needs of the society over a period of time, the mounting pressure of unemployment, particularly educated unemployment compelled the governments to undertake special employment programmes under different heads. These special employment programmes are mostly supplementary to the main Five Year Plans.

Further, to mitigate unemployment problem among educated youth, both the Central and State Governments also implemented some special schemes, Among these, an important scheme, exclusively meant for educated unemployed youth, is "Self Employment for Educated Unemployed Youth" (SEEUY) Scheme introduced on August 15,1983. The main objective of the scheme was to encourage the educated unemployed to undertake self-employment ventures in Industry, Service and Business sectors using the provision of financial packages. The scheme covers all educated unemployed youth who have the qualifications of matriculation and above and are within the taroeted age group of 18-35 years, and since 1999-2000 year onwards, even the candidates with 9th class passed and are up to 40 years age have been eligible. The District Industries Centre (DIC) in consultation with the "Lead Bank" of the district functions as the Nodel Agency for the implementation of the scheme. The banks provide a composite loan to the eligible candidates. Having introduced the New Economic Policy in 1991, the Government introduced the Prime Minister Rozgar Yojana (PMRY) Scheme on October 2, 1993 with new strategies and subsumed the SEEUY scheme into PMRY scheme from 1994-95 onwards,

And a period of about nine years has passed since the date of commencement of the scheme (PMRY). In this context, the present study aims at evaluating the working of self-employment schemes for educated unemployed youth, particularly PMRY scheme, at a micro level choosing three districts of the Telaiigana region in Andhra Pradesh as a case study.

2. Objectives of the Study

To examine the repayment behaviour of the PMRY beneficiaries in the three selected districts of Telangana region in Andhra Pradesh.

3. Hypotheses of the Study

The repayment of loan under the PMRY scheme is generally poor, and not uniform in rural and urban areas, in category-wise, family occupation-wise, gender-wise, and educational qualification-wise classification as well as between the Industry, Service and Business sectors.

4. Scope of the Study

Though the study is on "Working of self-employment schemes for Educated Unemployed Youth", it mainly focuses on the working of "Prime Minister Rozgar Yojana (PMRY) scheme. It is an empirical investigation. The study is confined to the three selected districts, namely, Ranga Reddy, Nalgonda and Mahabubnagar districts in the Telangana region of Andhra Pradesh. Of these three districts, Ranga Reddy district is developed, Nalgonda district is developing and Mahabubnagar district is backward on the basis of their demographic characteristics and employment situation.

This is a micro study based on inductive analysis. For this purpose, the units that received assistance are selected through a stratified random sampling method, to enable the researcher to draw inferences over the entire functioning of the PMRY Scheme with regard to income, employment generation and asset creation in the area covered by the study.

5. Methodology

Sources of data

The data were collected both from primary and secondary sources. The primary data have been collected from three districts of Telangana region in Andhra Pradesh. The situation in the three districts vath different levels of development was expected to indicate the impact of the PMRY scheme in the area of the study vath varying levels of development. In each district, 6 Mandals were selected by using the random sampling method. The Mandals selected were:

In the three districts, 150 beneficiaries were chosen through the random sampling method and the total number of sample adds up to 450. The data were collected from

	Ranga Reddy	Nalgonda	Mahabubnagar
Urban	Balanagar	Nalgonda (Town)	Mahabubnagar (Town)
	Rajendra Nagar	Miryalagada	Wanaparthy
	Secunderabad	Suryapet	Gadwal
Rural	Semshabad	Atmakur	Makthal
	Vikarabad	Choutuppal	Achampet
	Pargi	Narketpalli	Nagar Kurnool

each beneficiary with the help of a structured schedule and it was pre-tested before use. The schedule sought information, besides the socioeconomic characteristics of the beneficiaries, on training, role of the banks, role of the DICS, functioning of the units, impact of the scheme through income, employment generation, asset creation, problems faced by the beneficiaries and post-loan situation of the units and recoveries from the beneficiaries.

The secondary data were collected from the following sources of Central and State Government organisations : Development Commissioner, Small Scale Industries, New Delhi, Planning Commission,New Delhi, Commissionerate of Industries, Government of Andhra Pradesh, Hyderabad, General Manager- District Industrial Centre, Ranga Reddy, General Manager, District Industrial Centre, Nalgonda, General Manager, District Industrial Centre, Mahabubnagar, Directorate of Employment and Training, Government of Andhra Pradesh, Hyderabad, Directorate of Census Operation, Government of Andhra Pradesh, Hyderabad, First to Ninth Five Year Plan Documents, Planning Commission, Government of India, New Delhi, NSSO, 55th round "Employment and Unemployment-key results", Ministry of Statistics and Program Implementation, Government of India, Kolkafta, December 2000 and Head Office of Andhra Bank (i.e. the lead bank), Hyderabad.

Selection of the Sample

For studying the impact of the PMRY Scheme, structured schedules were separately prepared for beneficiaries. 150 beneficiaries were chosen in each of the three districts in the Telangana region of Andhra Pradesh on the basis of the stratified random sampling method. The strata were selected by giving equal importance to variables like rural and urban, male and female, new and old units and Industry, Business and Service sector wise in each of six Mandals from each district for adequate representation. Moreover, the beneficiaries were approached personally by the researcher with a structured schedule. Hence, the results were expected to be reliable.

Period of Study

The study covers a period of seven years of the functioning of PMRY Scheme. Accordingly, the period of study is from 1993-94 to 2001-2002, the year 1993-94 being the year of introduction of the Scheme.

Statistical tools used

Depending upon the necessity, tables, graphs and charts were used and supplemented with sophisticated statistical tools such as Co-efficient of Correlation (r), Coefficient of Regression, Chi-square test, t-test and ANOVA, and the data were processed through FOXPRO and Excel packages in the computers.

6. Limitations of the Study

The limitations of the study basically emanate from the limitations of data, which are appropriately explained in detail in each section. However, a broad outline is given below.

1) The study was based on the primary data collected from the various parts of the three districts– Ranga Reddy, Nalgonda and Mahabubnagar and supplemented

with the secondary data. Hence, the inductive analyses emanate from the data collected mainly from the three districts. Hence, interpretation holds good for those districts only though generalisation can be made for other districts, too.

2) Data relating to the recovery of the loan amount was maintained neither by the DICs nor did the bankers and beneficiaries disclose it. However, by verifying the beneficiaries' passbooks data vere collected.

An attempt is made in this paper to study the loan repayment and presented in section 1, and the hypotheses formulated are tested in section 11

Repayment is an important indicator of success for any loan programme. The prompt repayment of loan helps the bankers recycle the same amount to help other needy persons. non-repayment of loans not only limits the recycling of funds but also adversely affects the spirit of the scheme and viability of banks.

Therefore, in this section, the aspect of repayment is studied through activity-wise, area-wise, category-wise, family background-wise and educational qualification-wise analysis. Activity-wise repayment was analysed and presented in Table 1. From Table 1, it can be observed that :

1) Business sector units are able to pay the loan fast. In all the districts, about 47 per cent of the loan was recovered by the banks whereas only 41 per cent of the beneficiaries who started in Industrial sector unit could repay the loan amount- The Service sector unit proved to be further poor, as hardly 34 per cent are able to pay the loan.

2) An inter district comparison revealed that 50.44 per cent of the bank loan was repaid by the sample beneficiaries in Mahabubnagar district, followed by the Nalgonda district with 40.05 per cent, and Ranga Reddy district with 35.92 per cent.

3) An activity vase comparison revealed that among the three districts Nalgonda district topped with 48.84 per cent of the loan amount repaid by the industrial units.

4) In Service sector, the highest repayment of loan (35.75 per cent) was noticed in Ranga Reddy district and the lowest repayment was (Rs.32.92 per cent) noticed in Nalgonda district. The repayment rate noticed in Mahabubnagar district was mediocre with 34.78 per cent.

5) Finally, all sectors and three districts put together, 42.1 per cent of the loan amount was repaid by the sample beneficiaries- While the repayment in Mahabubnagar district was 50.44 per cent, it was about 40 per cent in Nalgonda district and the least repayment of 35.92 per cent was noticed in Ranga Reddy district.

Therefore, it is suggested that DIC's shall identify the viable units, non-viable units, and income generating units, no income-generated units and willful defaulters.

For willful defaulters, there should be stringent action as per the Revenue Recovery Act (RRA).

It is essential to evaluate the range of amount repaid by the sample beneficiaries in the selected districts as presented in Table.2.

1 It can be observed that Range of Repayment is around Rsl0,000 -20,000 in all the three districts. Table shows that 26 per cent of the beneficiaries from all the three districts repaid the loan to the above range.

2) Table also reveals that in Ranga Reddy district, Nalgonda district and Mahabubnagar district, the highest proportion of beneficiaries repaid the loan to the range of Rs 10000-20000.

3) 11 per cent of the beneficiaries in all the three districts in the area under study did not pay even a single pie to the banks. Further, the number of beneficiaries and their repayment range in the three districts was staggering.

4) When non-repayment is analysed, it can be seen that Ranga Reddy district topped with 26 per cent of the beneficiaries who failed to repay the loan to the extent of above Rs 50,000. Even in other districts, the proportion is more than 20 per cent. This reveals that the non-repayment in the entire three districts is quite alarming.

7. Repayment

Area-wise – Repayment

Repayment made by the beneficiaries is classified into rural area and urban area and is presented in Table 8.5.3. The following observations are made from the table:

1) 65 per cent of the rural beneficiaries in Ranga Reddy district, 53 per cent in Nalgonda district and 74 per cent in Mahabubnagar district are quite regular in repaying the loan to the bank.

2) About 9 per cent of the beneficiaries in all the three districts are categorised as defaulters.

3) About 29 per cent of the beneficiaries in Nalgonda district are making payment seasonally. In all the three districts, about 14 per cent of the beneficiaries are repaying seasonally.

4) About 13 per cent of the beneficiaries in all three districts are irregular in repayment.

Based on the above analysis, it can be stated that the repayment in general is not bad, and in Nalgonda district seasonal factors are influencing the repayment.

Category-wise - Repayment

Category wise repayment in the selected districts are presented in Table 8.4. The observations are as follows :

1) OC category beneficiaries are regular in repaying the loan. While in Ranga Reddy district, 74 per cent of the beneficiaries of OC category were regular, followed by 72 per cent in Mahabubnagar district and 68 per cent in Nalgonda district.

2) The number of SC& ST beneficiaries repaying the loan was very low, they were very regular in repaying the loan amount in Nalgonda and Mahabubnagar districts. However, 33 per cent of the beneficiaries of this category became defaulters in Ranga Reddy district, and 43 per cent were seasonally repaying the loan amount in Nalgonda district.

3) Category wise comparison reveals that 61 per cent of the BC category beneficiaries in Ranga Reddy district, followed by 60 per cent in Mahabubnagar district and 30 per cent in Nalgonda district, were regular in repaying the loan amount. However, 21 per cent in Nalgonda district, 15 per cent in Mahabubnagar district and 10 per cent in Ranga Reddy district were declared defaulters.

4) In Minority Community (MI), 77 per cent of the beneficiaries in Mahabubnagar district, followed by 45 per cent in Ranga Reddy district, and 40 per cent in Nalgonda district, were regular in repayment of the loan amount. However, 20 per cent of them became defaulters in Nalgonda district, which was followed by 18 per cent in Ranga Reddy district and 8 per cent in Mahabubnagar district.

5) An inter-district comparison reveals that the highest regular repayment with 70 per cent was noticed in Mahabubnagar district, follomed by Ranga Reddy district with 57.33 per cent and the least at 47 per cent was noticed in Nalgonda district whereas the highest irregular repayment of 17.33 per cent was noticed in Ranga Reddy district, folloiwd by Mahabubnagar district vath 14 per cent and Nalgonda district with 7 per cent. Further, 15 per cent of the beneficiaries became defaulters in Ranqa Reddy distinct, followed by Nalgonda district with 13.34 per cent and Mahabubnagar district with 13 per cent.

6) An inter-district comparison revealed that 15 per cent of the BC category beneficiaries were defaulters as noticed in Mahabubnagar district. And it was 21 per cent and 20 per cent in Nalgonda district and Ranga Reddy district respectively. Further, SC and ST category beneficiaries were 25 percent and 33 per cent in Ranga Reddy district. In case of OC categories at highest 14.7 per cent defaulters were noticed in Mahabubnagar district. Similarly, among the beneficiaries in BC category and Minority category, 21 per cent and 20 per cent became defaulters in Nalgonda district.

Family Occupation-wise Repayment

Family occupation-wise repayment in selected three districts was analysed and presented in Table 5.

1) It can be noticed from Table 5 that in Nalgonda district, 89 per cent of the beneficiaries hailing from family background of 'Government Servants' were irregular in repayment of loan. It was assumed that the performance of beneficiaries coming from different background be same. This reflects willful negligence on their part.

2) The inter district comparison revealed that the highest proportion of 84.85 per cent of the beneficiaries in Mahabubnagar district hailing from the family with 'business' as the background were regular in repaying the bank loan amount. Further, nearly 73.33 per cent of the beneficiaries hailing from the family with 'services' as the background' in Mahabubnagar district were regular in repaying the loan amount. Similarly, 62.5 per cent of the beneficiaries hailing from the family with 'Business' as the background in Ranga Reddy district were regular in repaying the bank loan amount.

3) The highest proportion of 33.33 per cent of the beneficiaries hailing from the family with 'artisans' as the background became defaulters in Mahabubnagar district, followed by 19.44 per cent and 18.52 per cent of beneficiaries hailing from 'services' and agricultural as their family background became defaulters in Ranga reddy district, followed by 9.76 per cent of the beneficiaries hailing from the family with 'business' as the background in Nalgonda district.

Thus, it can be stated that the maximum of 84.85 per cent of the beneficiaries hailed from the family with 'business' as the background were regular in repaying the loan in Mahabubnagar district, whereas only 18.52 per cent each hailing from the family with agriculture as the background were noticed defaulters in Ranga Reddy and in Mahabubnagar districts.

Male / Female-wise Repayment

The role of male and female in repaying the loan amount in the selected districts is presented in Table 6.

1) By observing the table, it can be noticed that 52.38 per cent of the female beneficiaries were regularly repaying the loan; significantly, it was more than the repayment rate in male category (i.e. 51.85 per cent) in Ranga Reddy (developed) district. Further, males are repaying the loan regularly in Mahabubnagar district (77.5per cent), followed by Nalgonda district vath 57.5 per cent and Ranga Reddy district with 51.85 per cent.

2) In all the three districts, female beneficiaries are good in repayment in Mahabubnagar district, followed by Ranga Reddy and Nalgonda districts.

3) The highest proportion of defaulters was noticed in the female category (20 per cent) in Nalgonda district, followed by Ranga Reddy vath 19.05 per cent. 13.89 per cent male defaulters were noticed in the Ranga Reddy district, followed by Nalgonda district with 10.83 per cent and Mahabubnagar district with 9.17 per cent.

It can be stated that the highest regular repayment among males was noticed as 77.5 per cent in Mahabubnagar district, and the highest percentage of defaulters in female category was noticed as 20 per cent in Nalgonda district. Significantly, in a relatively developed district, female repayment rate was high due to commitment and well settlement in their life. However, in Nalgonda district, there was no seriousness in beneficiaries with regard to loan repayment.

Educational qualifications-wise Repayment

Educational qualification wise-repayment by the sample beneficiaries in the selected districts is presented in Table 7.

1) It can be noticed from table that 74 per cent of the sample beneficiaries who studied upto 'SSC level qualification' were regular in repaying the loan in Mahabubnagar district, followed by Ranga Reddy district with 64 per cent and Nalgonda district with only 53 per cent.

2) 70 per cent of the sample beneficiaries who are possessing 'intermediate qualification' were regular in repaying the loan amount in Nalgonda district, followed by Mahabubnagar district with 57 per cent and Ranga Reddy district with 55 per cent.

3) 'Degree and above degree qualifications' beneficiaries were very few but they were regular in repayment of the bank loan.

4) Out of eleven 'ITI educational qualification' persons, only two persons became defaulters in Mahabubnagar district.

5) Out of 9 (nine) beneficiaries with 'technical qualification', 2 beneficiaries were defaulters in Ranga Reddy district, and out of two beneficiaries with technical qualifications in Nalgonda district, one beneficiary was regular in repaying the loan and another one became a defaulter.

6) 12 per cent of the 'SSC qualification' persons (defaulters) were not repaying the loan amount in Nalgonda district, and 14 per cent of the beneficiaries were defaulters in Mahabubnagar district. These defaulters were possessing intermediate qualification.

7) Finally, SSC qualification beneficiaries were regular in repaying the bank loan amount in Mahabubnagar district, and similarly, Intermediate candidates were regular in Nalgonda district.

8. Section 11 : Testing of Hypothesis

An attempt is made in this section to test the hypotheses formulated for the study.

The hypothesis formulated for the study "the repayment of loan under the scheme is generally poor, and not uniform in rural and urban areas, in category-wise, family occupation-wise, gender-wise and educational qualification-wise as well as among the Industry, Service and Business sectors, and the performance of the scheme would

be better in developed district when compared to developing and backward districts". An activity wise analysis in respect of repayment revealed that 50.44 per cent of the bank loan was repaid by the sample beneficiaries of Mahabubnagar district and least repayment 35.92 per cent was noticed in Ranga Reddy district. Sector wise comparison revealed that the industrial sector beneficiaries were regular in repayment in Nalgonda district, followed by Service sector in Ranga Reddy district and Business Sector in Mahabubnagar district. However, 24 per cent of the beneficiaries did not pay even a single pie to the bank in Nalgonda district, followed by 17 per cent in Ranga Reddy district and 15 per cent in Mahabubnagar district. But, more number of defaulters were found in Ranga Reddy and fewer defaulters were found in Mahabubnagar district (backward district). Further, the rural beneficiaries were very regular in repaying the loan when compared to urban beneficiaries even in the backward district of Mahabubnagar.

Moreover, 49 per cent of the OC category beneficiaries in Mahabubnagar were regular in repaying the loan while 61 per cent in BC category were regular in Ranga Reddy, and 100 per cent of each SC and ST category in Mahabubnagar and Nalgonda districts were regular in repaying the bank loan. Nevertheless, 14.7 per cent of OC category beneficiaries in Mahabubnagar district became defaulters. 21 per cent of BC category beneficiaries in Nalgonda district, 25 per cent of SC and 33 per cent of ST category beneficiaries became defaulters in Ranga Reddy district and 20 per cent of the minority beneficiaries were defaulters in Nalgonda district.

An enquiry into the family background of the beneficiaries regarding the repayment revealed that beneficiaries with agriculture as family background and private service sector beneficiaries in Nalgonda district were regular in repaying the loan to the banks. Similarly beneficiaries whose family background was Business sector in Mahabubnagar district were regular in repaying the loan amount. However, the highest number of defaulters was noticed in artisan's family in Mahabubnagar district and even those beneficiaries hailing from the family with services as the background in Ranga Reddy district were also defaulting.

Further, an analysis about male and female beneficiaries regarding repayment of the bank loan revealed that the highest regular repayment (77.5 per cent) was noticed from males in Mahabubnagar district and repayment rates in female were high in Ranga Reddy district, whereas highest percentage of defaulters (20 per cent) was noticed in female category in Nalgonda districts.

Qualification wise analysis reveals that beneficiaries with SSC qualification were regular in repaying the loan amount to bank in Mahabubnagar district. Similarly, intermediate candidates in Nalgonda district were regular.

TABLE 1

ACTIVITY WISE REPAYMENT BY THE SAMPLE BENEFICIARIES IN THE SELECTED DISTRICTS

Ranga Reddy District								
Repayment	Industry	%	Services	%	Business	%	Total	%
Repaid	432647	39.22	739050	35.75	1774050	35.27	2945747	35.92
Due	670453	60.78	1328424	64.25	3255795	64.73	5254672	64.08
Total Loan	1103100	100.00	2067474	100.00	5029845	100.00	8200419	100.00
Nalgonda								
Repament	Industry	%	Services	%	Business	%	Total	%
Repaid	448977	48.84	1124481	32.92	1803750	44.02	3377208	40.05
Due	470341	51.16	2291423	67.08	2293522	55.98	5055286	59.95
Total Loan	919318	100.00	3415904	100	4097272	100	8432494	100
Mahabubnagar								
Repament	Industry	%	Services	%	Business	%	Total	%
Repaid	409650	37.01	792667	34.78	2895972	61.12	4098289	50.44
Due	697350	62.99	1486258	65.22	1842528	38.88	4026136	49.56
Total Loan	1107000	100.00	2278925	100	4738500	100	8124425	100
Three District Total								
Repaid	12,91,274	41.26	2656198	34.22	64,73,772	46.69	104,21,244	42.1
Due	18,38,144	58.74	51,06,105	65.58	73,91,845	53.31	1,43,36,094	57.9
Total Loan	31,27,418	100%	77,62,303	100%	138,65,617	100%	247,57,338	100%

Source: Primary data

TABLE 2
DISTRIBUTION OF THE REPAID AND NOT REPAID AMOUNT BY THE SAMPLE BENEFICIARIES IN THE SELECTED DISTRICTS

Range for Repayment	Ranga Reddy				Nalgonda				Mahabubnagar				Total			
	Repaid		Non-repaid		Repaid		Non-repaid		Repaid		Non-repaid		Repaid		Non-repaid	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Zero	0	0	25	17	0	0	36	24	0	0	23	15	0	0	48	11
1 - 10,000	28	19	11	7	32	21	6	4	33	22	10	7	93	21	53	12
10,001-20,000	42	28	23	15	34	23	9	6	41	27	21	14	117	26	78	17
20,001-30,000	27	18	21	14	32	21	27	18	32	21	25	17	91	20	78	17
30,001-40,000	20	13	21	14	36	24	26	17	17	11	23	15	73	16	80	18
40,001-50,000	3	2	10	7	5	3	16	11	12	8	16	11	56	12	31	7
Above 50,000	30	20	39	26	11	8	30	20	15	10	32	21	20	4	82	18
Total	150	100	150	100	150	100	150	100	150	100	150	100	150	100	150	100

Source: Primary data

TABLE 3

RURAL AND URBAN AREA WISE REPAYMENT IN THE SELECTED DISTRICTS

District	Rural					Urban					Total				Total
	R	IR	S	D	Total	R	IR	S	D	Total	R	IR	S	D	
Ranga Reddy	61	12	11	5	89	36	9	7	9	61	97	21	18	14	150
	(69)	(13)	(12)	(6)	(100)	(59)	(15)	(11)	(15)	(100)	(65)	(14)	(12)	(9)	
Nalgonda	43	3	28	8	82	37	10	15	6	68	80	13	43	14	150
	(52)	(4)	(34)	(10)	(100)	(54)	(15)	(22)	(9)	(100)	(53)	(9)	(29)	(9)	
Mahabubnagar	76	15	3	8	102	35	8	0	5	48	111	23	3	13	150
	(75)	(15)	(3)	(8)	(100)	(73)	(17)	0	(10)	(100)	(74)	(15)	(2)	(9)	
Total	180	30	42	21	273	108	27	22	20	117	288	57	64	41	450
	(66)	(11)	(15)	(8)	(100)	(61)	(15)	(12)	(11)	(100)	(64)	(13)	(14)	(9)	

Source : Primary data
Parenthesis indicate percentage of total
R = Regular : Regular repayment means, the beneficiaries were
Repaying the loan amount to bank every month
I = Irregular : Irregular means, the beneficiaries were not regularly repaying the loan to the bank (i.e. not every month)
S = Seasonal : Seasonal means, the beneficiaries were repaying in the seasons only
D = Defaulter : Defaulter means, the beneficiaries so for not paid single pai to banks.

TABLE .4

DISTRIBUTION CATEGORY-WISE REPAYMENT BY THE SAMPLE BENEFICIARIES IN THE SELECTED DISTRICTS

Category	Repayment								Total	
	Regular		Irregular		Seasonal		Defaulter			
	No	%	No	%	No	%	No	%	No	%
Ranga Reddy										
OC	35	74	5	11	2	4	5	11	47	31.34
BC	42	61	12	17	8	12	7	10	69	46.00
SC	2	10	7	35	6	30	5	25	20	13.33
ST	2	67	0	0	0	0	1	33	3	2.00
MI	5	45	2	18	2	18	2	18	11	7.33
Total	86	57.33	26	17.33	18	12	20	13.34	150	100
Nalgonda										
OC	34	68	3	6	8	16	5	10	50	33.33
BC	22	30	7	10	29	40	15	21	73	48.67
SC	5	100	0	0	0	0	0	0	5	3.33
ST	4	57	0	0	3	43	0	0	7	4.67
MI	6	40	0	0	6	40	3	20	15	10.00
Total	71	47	10	7	46	31	23	15	150	100
Mahabubnagar										
OC	49	72.1	7	10.3	2	2.9	10	14.7	68	45.33
BC	28	60	10	21.0	2	4	7	15.0	47	31.33
SC	6	100	0	0	0	0	0	0	6	04.00
ST	3	100	0	0	0	0	0	0	3	2.00
MI	20	77	4	15	0	0	2	8	26	17.34
Total	106	70	21	14	4	3	19	13	150	100
Total Three Districts										
OC	118	72	15	9	12	7	20	12	165	37
BC	92	49	29	16	39	21	27	14	189	42
SC	13	42	7	23	6	12	5	16	31	07
ST	9	69	0	0	3	23	1	8	13	3
MI	31	60	6	12	8	15	7	13	52	11
Total	263	58	57	13	68	15	62	14	450	100

Source: Primary data

TABLE 5

DISTRIBUTION OF THE SAMPLE BENEFICIARIES FAMILY BACKGROUND WISE REPAYMENT WISE IN THE SELECTED DISTRICTS

Ranga Reddy												
Repayment	Agriculture	%	Artisans	%	Business	%	Govt. Servi	%	Services	%	Total	%
Regular	13	48.15	2	100	40	62.5	9	42.86	22	61.11	86	57.33
Irregular	5	18.52	0	0	11	17.19	4	19.05	2	5.56	22	14.67
Seasonal	4	14.81	0	0	7	10.94	5	23.81	5	13.89	21	14.00
Defaulter	5	18.52	0	0	6	9.38	3	14.29	7	19.44	21	14.00
Total	**27**	**100.00**	**2**	**100**	**64**	**100**	**21**	**100.00**	**36**	**100.00**	**150**	**100.00**
Nalgonda												
Repayment	Agriculture	%	Artisans	%	Business	%	Govt. Servi	%	Services	%	Total	%
Regular	33	52.38	15	50	30	73.17	0	0	7	100	85	56.67
Irregular	14	22.22	6	20	0	0.00	8	88.89	0	0	28	18.67
Seasonal	10	15.87	6	20	7	17.07	1	11.11	0	0	24	16.00
Defaulter	6	9.52	3	10	4	9.76	0	0	0	0	13	8.67
Total	**63**	**100.00**	**30**	**100**	**41**	**100.00**	**9**	**100**	**7**	**100**	**150**	**100.00**
Mahabubnagar												
Repayment	Agriculture	%	Artisans	%	Business	%	Govt. Servi	%	Services	%	Total	%
Regular	13	48.15	4	33.33	56	84.85	22	73.33	2	13.33	97	64.67
Irregular	9	33.33	4	33.33	3	4.55	5	16.67	13	86.67	34	22.67
Seasonal	0	0.00	0	0.00	2	3.03	1	3.33	0	0.00	3	2.00
Defaulter	5	18.52	4	33.33	5	7.58	2	6.67	0	0.00	16	10.67
Total	**27**	**100.00**	**12**	**100.00**	**66**	**100.00**	**30**	**100.00**	**15**	**100.00**	**150**	**100.00**

Source: Primary data

TABLE. 6

REPAYMENT BY MALE AND FEMALE BENEFICIARIES

Particulars	Ranga Reddy				Nalgonda				Mahabubnagar			
	Male	%	Female	%	Male	%	Female	%	Male	%	Female	%
Regular	56	51.85	22	52.38	69	57.5	15	50	93	77.5	18	60
Irregular	22	20.37	4	9.52	10	8.33	3	10	13	10.83	10	33.3
Seasonal	15	13.89	8	19.05	28	23.33	6	20	3	2.5	0	0
Defaulter	15	13.89	8	19.05	13	10.83	6	20	11	9.17	2	6.67
Total	108	100.00	42	100.00	120	100	30	100	120	100	30	100

Source: Primary data

TABLE 7

EDUCATION QUALIFICATION WISE REPAYMENT BY THE SAMPLE BENEFICIARIES IN SELECTED DISTRICTS

Repay-ment	Upto SSC		Inter		Degree		Above Degree		ITI		Technical		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Ranga Reddy														
Regular	67	64	16	55	2	100	5	100	-	-	7	67	97	65
Irregular	13	12	11	38	-	-	-	-	-	-	-	-	24	16
Seasonal	16	15	2	7	-	-	-	-	-	-	-	-	18	12
Defaulter	9	9	0	0	-	-	-	-	-	-	2	33	11	7
Total	105	100	29	100	2	100	5	100	-	-	9	100	150	100
Nalgonda														
Regular	62	53	16	70	5	100	-	-	2	100	1	50	86	57
Irregular	8	6	4	17	-	-	-	-	-	-	-	-	12	8
Seasonal	34	29	1	4	-	-	-	-	-	-	-	-	35	23
Defaulter	14	12	2	9	-	-	-	-	-	-	1	50	17	12
Total	118	100	23	100	5	100	-	-	2	100	2	100	150	100
Mahabubnagar														
Regular	87	74	8	57	2	100	5	100	9	82	-	-	111	74
Irregular	17	15	4	29	-	-	-	-	-	-	-	-	21	14
Seasonal	3	2	-	-	-	-	-	-	-	-	-	-	3	2
Defaulter	11	9	2	14	-	-	-	-	2	18	-	-	15	10
Total	118	100	14	100	2	100	5	100	11	100	-	-	150	100
Total Three Districts														
Regular	216	63	40	61	9	100	10	100	11	85	8	73	294	65
Irregular	38	11	19	28	-	-	-	-	-	-	-	-	57	13
Seasonal	53	16	3	5	-	-	-	-	-	-	-	-	56	12
Defaulter	34	10	4	6	-	-	-	-	2	15	3	17	43	10
Total	**341**	**100**	**66**	**100**	**9**	**100**	**10**	**100**	**11**	**100**	**11**	**100**	**450**	**100**

Source: Primary data

Arthaniti 3 (1-2), 84-106 / 2004

To free ride or not to free ride? Role of patterning and feedback in the public goods game*

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Abstract

We study a public goods game where subjects get feedback either after every round (as is the usual practice in public goods experiments) or intermittently, after every few rounds We find that the intermittent feedback helps to mitigate problems of free riding because subjects in this treatment focus more on a string of choices rather than deciding on a case by case basis as in the round-by-round feedback treatment.

JEL Classification : C72, C91, C92

Keywords : Public goods; voluntary contributions mechanism; patterned feedback; free riding; expectations

1. Introduction

The incentive to free-ride in the course of private provision of a public good via voluntary contributions has been the subject of much economic research.[1] Economists have tried to capture the tension between contributing to a public good or free-riding on others' contributions via simple laboratory experiments in order to understand the factors that impact behavior in such situations. Ledyard (1995, p. 112) describes a typical public goods experiment in the following way. A group of four subjects are gathered in a room They are each given a sum of money (say $5) and they are told that they can keep any or all of this amount. Or if they want, they can contribute some or all of this amount to a public pool. However any amount contributed to a public pool is multiplied by a factor greater than 1 (say 2) by the experimenter. This multiplied

* We are grateful to Wellesley College for providing the funds used to run the experiments for this study. The authors would like to thank Pushkar Maitra for extensive feedback on the current draft. We also thank Debajyoti Chakrabarty, S. Brock Blomberg, Bradley Ruffle, Paul Strand, Akila Weerapana and students in the Spring 2002 Behavioral Economics course at Wellesley College for comments and insight. The usual disclaimer applies.

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[1] See Marwell and Ames (1981) Andreoni (1988), Isaac, McCue and Plott (1985), Isaac, Walker and Thomas (1984), Isaac and Walker (1988a, 1988b), Kim and Walker (1984) among others.

amount is then distributed equally between the four group members. The socially optimal outcome in this game is for every player to contribute the entire amount to the public pool. If every one contributes her entire endowment of $5 then total contributions to the public pool are $20 which is doubled to $40 by the experimenter and redistributed back to the group members, netting each person $10. Each member then gets a 100% return on her initial investment. However individual rationality suggests a different course of action. Think about an individual player trying to decide how much to contribute. If this individual contributes $1 and no one else contributes anything, then the $1 is doubled to $2. Distributed equally between the four players, this gives each player $0.50. The player who contributed is worse off (incurs a 50% loss on the investment) while every other player is better off at the expense of the player who contributed. Thus if a player does not contribute, then she is no worse off if no one else contributes, but she is actually better off if some others contribute. Game theory suggests that faced with a situation like this, every self-interested player will engage in strong free riding behavior by not contributing any money to the public pool at all, since free riding is the dominant strategy.

Prior researchers in the area have observed certain behavioural regularities in public goods experiments. First, the hypothesis of complete free riding is not borne out in one-shot games. While individual contributions vary quite a bit, still groups of subjects, on average, manage to contribute around 40% to 60% of the Pareto-efficient level if the game is played only once. Second, when the game is repeated for a number of rounds, contributions start off around 40% to 60% and then "decay" over time towards the free-riding level, although total free-riding is seldom realized. So free-riding occurs but not as much as is predicted by theory.[2]

Andreoni (1988, p. 292) suggests that there are two possible explanations for this observed decay in contributions over time. First, the learning hypothesis holds that a one-shot play of the game is not sufficient for the subjects to learn the exact incentives and the dominant strategy. Repeated play allows such learning and so over time, with repeated trials, subjects learn to free ride. However, this test of learning as an explanation of decay is confounded by the fact that repetition allows subjects to signal future moves to each other as well as to infer each other's strategies via contributions to the public account. This is the basis of the alternative - "strategies"-hypothesis. Andreoni (1988, p. 293-4) points out.

> "The free riding equilibrium rests on the assumption that all subjects believe that all other subjects will be behaving rationally. However this information may be incomplete. In particular, subject Y may believe that

[2] Isaac, Walker and Thomas (1984), Isaac, McCue and Plott (1985), Isaac and Walker (1988a, 1988b), Kim and Walker (1984) and Andreoni (1988). Ledyard (1995) provides a review of much of this literature.

his partners will possibly behave irrationally (perhaps because they have not yet learned the incentives). Then if Y free rides he will educate his partners. As a result any initial equilibrium will unravel to the (less lucrative) free riding equilibrium. Moreover, if Y thinks that his partners think *he* does not understand free riding, then by free riding he will reveal himself to be rational. Again, any cooperation will unravel to free riding. Hence, even if all the subjects understand free riding, they may choose a strategy of investing some in the public good to conceal the fact that they are rational. However in the known end-period free riding is always optimal. In anticipation of the end-period (using backward induction), subjects are likely to start "bailing out". Hence, it may be an incomplete information Nash equilibrium strategy to cooperate early in the game, but free ride later in the game."[3]

Andreoni (1988) examines the strategies and learning hypothesis but fails to come up with any definitive conclusions. Subsequently, this line of research has spawned a large number of papers. A review of this entire line of research is found in Andreoni and Croson (1998).

Ours is a preliminary study where we propose to explore the phenomenon of contributions decay from a different perspective, with the aim of re-evaluating the strategies versus learning hypothesis. The repeated public goods game is really a variant of a repeated play prisoner's dilemma with contributing being analogous to cooperating and free riding analogous to defecting. Defection produces higher rewards on any trial but by inciting others into defecting, it lowers long-term rewards. Contribution, on the other hand, might not maximize rewards on each trial but has the potential to increase long-term rewards by sustaining cooperation by others. It has been pointed out that this repeated play prisoner's dilemma in the social sphere is analogous to self-control in the personal sphere. As Silverstein et al (1998, p. 125) point out "self-control is analogous to consistent cooperation while impulsiveness is analogous to momentary defection." In a prisoner's dilemma game, the subject's alternatives are identical to the alternatives provided in many studies of self-control – a smaller-sooner reinforcer (defection/impulsiveness) versus a larger-later reinforcer (cooperation/self-control) See Rachlin (1995a, 1995b).

It has also been suggested that a temporal patterning of trials (a string of rapid trials followed by a relatively long inter-trial interval, followed by another string and so forth) increases cooperation by encouraging subjects to choose, not on a case-by-case basis, but for the whole string at once. (Silverstein et al., 1998) This tendency is

[3] See Andreoni (1988) for detailed discussions. It will be clear to most readers that Andreoni's argument is based on the idea of rational cooperation in finitely repeated prisoner's dilemma games as expressed in Kreps et al. (1982).

further strengthened by the absence of feedback during the string. In everyday self-control tasks, such global decision making tends to reduce impulsiveness and increase self-control (cooperation).[4]

We design an experiment to test the conjecture that such patterning of trials will lead to higher cooperation and lower rates of defection in the public goods game. Two groups of subjects are randomly assigned to (1) a *round-by-round feedback* treatment and (2) an *intermittent feedback* treatment. In the round-by-round feedback treatment, a control group of 20 players play the conventional public goods game for 10 periods and receive feedback about total contributions to the public account and their earnings at the end of the every round as is the usual custom in all public goods experiments. In the intermittent feedback treatment, a second group plays the same exact game with the same parameters, but receives feedback about contributions to the public account and their earnings intermittently. More specifically this group receives feedback at the end of period 3 (about contributions in periods 1 to 3), period 6 (for periods 4 to 6) and finally at the end of period 10 (for periods 7 to 10). The subjects know a priori that they will play for exactly ten rounds. We also ask each subject, at the very beginning of the experiment, about how much she expects other members of the group to contribute. This allows us to observe to what extent contributions by subjects in the game depend on what they think other group members will do. We expected that the intermittent feedback group would exhibit higher cooperation and lower rates of decay than the round-by-round feedback group.

Our conjecture about lower rates of decay in the intermittent feedback treatment is vindicated by the experimental results but our conjecture about higher cooperation is not. We find that the round-by-round feedback group exhibits patterns of decay similar to those reported in previous experimental work, while the intermittent feedback group does not. More importantly, for the latter group there is no decay in contributions over time and no significant difference in average contributions between round 1 and round 10. Moreover we find, in keeping with prior research, that there is a strong positive correlation between what a subject contributes and what she expects other group members to contribute. To our surprise though, average contribution by the round-by-round feedback group is significantly higher in the initial rounds. We will proceed as follows. In the next section we describe the exact design of the experiment. Section 3 presents the results. Section 4 discusses our findings. In Section 5 we offer some concluding thoughts and, in keeping with the preliminary nature of this study, suggest directions for future research.

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[4] McReynold et al. (1983) show, for instance, that dieters who plan their meals for the day in the morning (i.e. choose a string of meals) eat less than those who decide on a meal-by-meal basis. Kudadjie-Gyamfi and Rachlin (1996) also find that such temporal patterning of trials increase self-control.

2. Experimental Design

The study uses non-computerized classroom experiments with 40 subjects in 10 four-person groups. 5 of those 4-person groups (20 subjects) take part in the round-by-round feedback treatment while the other 5 (another 20 subjects) take part in the intermittent feedback treatment. Each group takes part in one session of the experiment with each session consisting of 10 rounds. The subjects were recruited from among the staff and students of Wellesley College via postings on electronic bulletin boards. The subjects were given a copy of the instructions to read and the instructions were also read aloud.[5] Before round one, the subjects were asked to predict what each of the other 3 group members would contribute to the public good in the first round. Each round worked in the following way. At the beginning of each round each subject is given an endowment of ten tokens. The tokens could be invested in either a private account or a public account. The number of tokens invested in the public account was written on a slip of paper, which was handed to the experimenter to tally. The total tokens invested in the public account were added, and the sum was then doubled and the resulting amount equally distributed among the four group members. The total contributions to the public account, the doubled amount and the returns to each subject from the public account are announced publicly. Tokens contributed to the private account do not get multiplied. In each round a subject's earnings equal the number of tokens in the private account plus the returns from the public account. A new round starts after that with each subject getting a fresh endowment of 10 tokens.

The incentive properties of this game are well known. The payoff for each subject i in any period t is

$$\Pi_{it} = 10 - C_{it} + 0.5\sum_{i=1}^{4} C_{it} \; ; \mathrm{t} = 1, \ldots 10.$$

In our case the marginal per capita return from a contribution to the public good is 0.5 since all contributions are doubled and split 4-ways. The total payoff to a subject is the sum of the per-period payoffs over all 10 rounds $\left(\sum_{t=1}^{10} \Pi_{it}\right)$. It follows that full free riding $\left(C_{it} = 0\right)$ is a dominant strategy in the stage game. This is because $\frac{\partial \Pi_{it}}{\partial C_{it}} = -1 + 0.5 < 0; \forall t$. However, the aggregate payoff $\sum_{i=1}^{4} \Pi_{it} \forall t$ is maximized if

[5] A copy of the instructions is available from the corresponding author upon request.

each group member fully cooperates $(C_{it} = 10)$, because $\frac{\partial \sum_{i=1}^{4} \Pi_{it}}{\partial C_{it}} = -1 + 2 > 0; \forall t$.

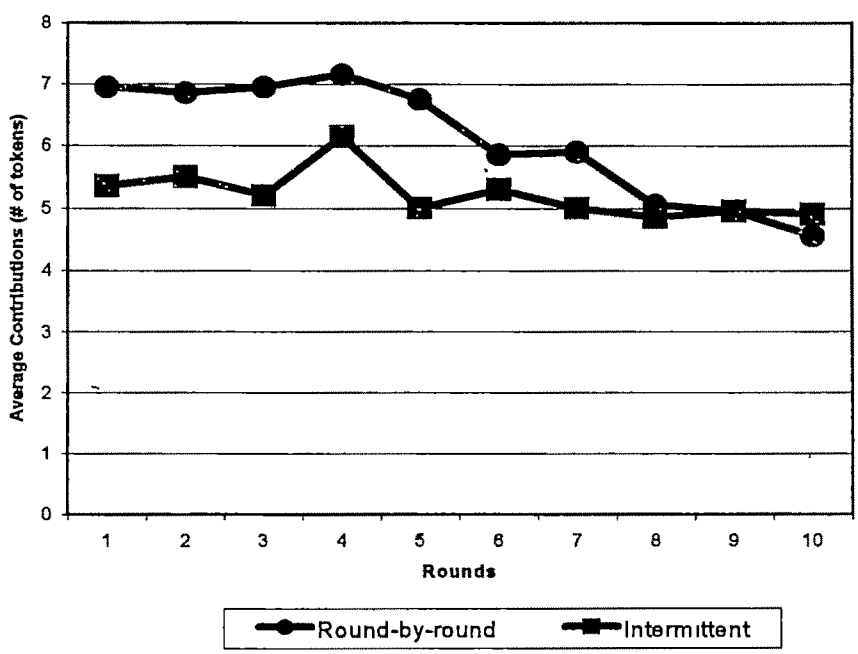
In the round-by-round feedback treatment, the subjects were told about their returns from the public account after each round as is usual in public goods experiments. In the intermittent feedback treatment subjects were told at the end of rounds 3, 6 and 10 what the contributions were to the public account in the preceding rounds. For example, before round 4, participants were given feedback on contributions for Rounds 1, 2 and 3 respectively. At the end of the game, the number of tokens accumulated in each round were summed and exchanged for cash at the rate of \$0.05 per token. The experiment lasted about 45 minutes and average earnings were approximately US \$8.75.

3. Experimental Results

3.1 Overview

Figure 1 shows the pattern of average contributions over 10 rounds in the round-by-round and intermittent feedback treatments. Several interesting results emerge from comparing the patterns of contributions between the two treatments.

Figure 1: Average Contributions by Treatment



There is a significant difference between the first round and last round contribution in the round-by-round feedback treatment, whereas no such difference exists in the intermittent treatment. See Table 1 for a breakdown of contributions by round in each treatment.[6] In the round-by-round treatment, mean contribution in the first round is 6.95 tokens (69.5%), which drops to 4.55 tokens (45.5%) by the tenth round. Using a t-test, we find that the first round and tenth round contributions are significantly different from one another. ($t = 2.49$, $p = 0.02$). The non-parametric Wilcoxon signrank test (which is a test for the equality of matched pairs of observations - the null hypothesis being that that both distributions are the same) bears out this conclusion ($z = 2.20$, $p = 0.03$). In the intermittent feedback treatment, the mean contribution in the first round is 5.35 tokens (53.5%), which only decays to 4.9 tokens (49%) in the last round. This is not a significant difference using either a t-test or a Wilcoxon signrank test ($t = 0.66$, $p = 0.52$; $z = 0.62$, $p = 0.54$ respectively).

We are interested in the dynamics of the contributions to the public good – specifically how contributions in period t respond to contributions in previous periods as well as group contributions in previous periods. Let us define C_{it} as the contribution of player i in period t. We have 40 players, each choosing a contribution for 10 periods, thereby giving us 400 observations. The observed contribution C_{it} is bound by zero from below and by ten (the token endowment) from above and so equals the desired contribution, C_{it}^* (which is a latent variable) if and only if $0 \le C_{it}^* \le 10$ and therefore we have.

$$C_{it} = \begin{cases} 0, \text{ if } C_{it}^* < 0 \\ C_{it}^*, \text{ if } 0 \le C_{it}^* \le 10 \\ 10, \text{ if } C_{it}^* > 10 \end{cases}$$

We use a random effects Tobit model to derive our coefficient estimates.

We find that the rates of decay in contribution are different in the two treatments i.e. the contribution function in the round-by-round treatment has a greater negative slope than the contribution function in the intermittent treatment. One way to show this is to simply run a Tobit regression of contributions against round (going from 1 to 10) as the independent variable for each treatment. If we do that then we find that the coefficient for round is negative (-0.38) and significantly different from zero ($z = -5.46$, $p = 0.00$) in the round-by-round treatment whereas in the intermittent treatment the coefficient of round is negative (-0.116) but this value is only marginally significant ($z = -1.91$, $p = 0.06$). However when we separate the data by treatment we are using

[6] A detailed breakdown of the contribution made by each subject in every round for the two treatments is available from the corresponding author.

only half the total observations. Instead we can use all the 400 observations and test for differences in the slopes by using an interaction term involving round and treatment. We performed a regression of average contributions per round on three independent variables. These include (1) **round**, (2) **group**, a dummy variable that equals 0 for the round-by-round treatment and 1 for the intermittent treatment and finally (3) **group*round**, an interaction term between group and round. A significant coefficient on group*round will demonstrate that the slopes for the two different treatments are indeed different. The coefficient estimates are provided in Table 2. The coefficient of the interaction term is 0.263 which is significantly different from zero ($z = 2.85$, $p = 0.004$) showing that the two slopes – and therefore the respective rates of decay - are indeed different from one another.

What is surprising is that round 1 contributions in the round-by-round treatment are significantly higher at 69.5% compared to the intermittent treatment at 53.5% ($t = 1.86$, $p = 0.07$ on a t-test and $z = 2.00$, $p = 0.05$ on a Wilcoxon signrank test). Overall average contributions are also significantly different. For the round-by-round treatment the average over all rounds is 60.95% while for the intermittent treatment it is 52.2%. This difference is significant using either a t-test ($t = 3.66$, $p = 0.01$) or a signrank test ($z = 2.451$, $p = 0.01$). This overall difference is driven by the large and significant differences in rounds 1 and 3.[7] Except for rounds 1 and 3, contributions in the remaining eight rounds are not significantly different (at the 5% level) in the two treatments using a Wilcoxon test. If we ignore the first three rounds and look at only rounds 4 through 10, then the average contributions for the round-by-round treatment is 57.4% while the average for the intermittent treatment is 51.6%. This difference is not significant ($t = 0.775$, $p = 0.44$ on a t-test; $z = 1.56$, $p = 0.12$ on a signrank test).

3.2 Role of Expectations

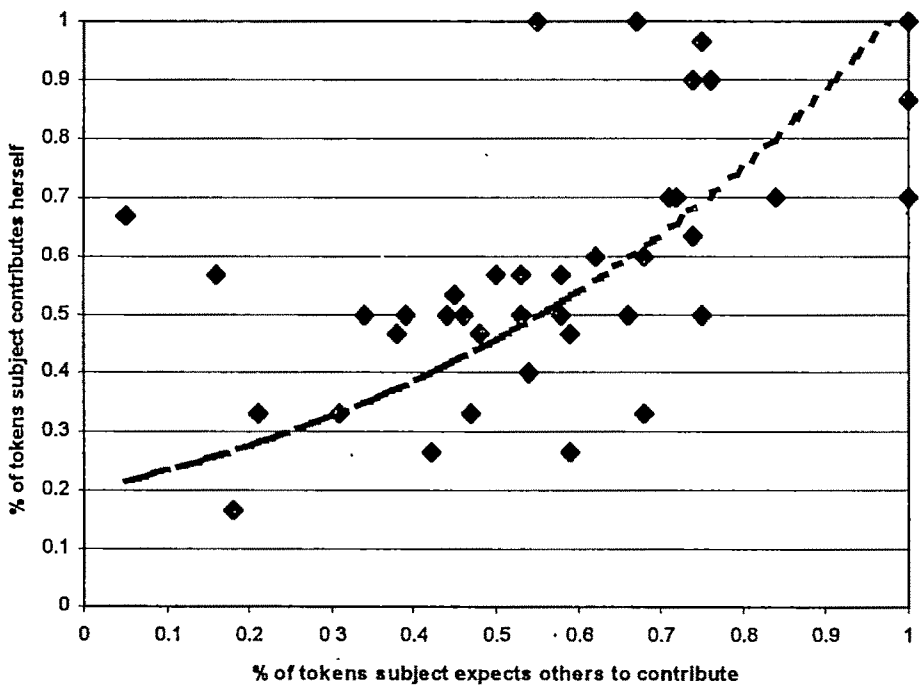
As mentioned above, before round one, each subject was asked to predict how much she thought the other three group members would contribute to the public good in round 1. Their answer to this question provides us with their beliefs about the average contribution of their group members in round 1. We find that there is a strong positive correlation between expectations and average contributions as well as between expectations and round 1 contributions.[8] The Spearman rank correlation coefficient between average expectations and round 1 contributions is 0.668 with a p-value of 0.000 and that between expectations and average contributions is 0.597 with a corresponding p-value of 0.000. In figure 2 we graph subjects' expectations of others'

[7] The average for round 3 is 69 5% for the round-by-round treatment and 52% for the intermittent treatment. This difference is significant using a t-test ($t = 2.38$, $p = 0.03$) or a signrank test ($z = 2.215$, $p = 0.03$).

[8] Croson (1995) also finds a strong positive correlation between subjects' contributions to a public good and their beliefs about how much others were contributing.

contributions and their own contributions. The x-axis shows what each subject expects others to contribute i.e. what percentage of their token endowments the other subjects in the group will contribute to the public account. The y-axis shows how the subjects own contributions (in percentage terms) vary with what she expects the others to contribute. As is clear from the figure, there is a strong positive relation between the two, i.e. the subjects who expect others to contribute more, also contribute more. Generally we find that both groups of subjects exhibit high expectations. In the round-by-round feedback treatment subjects on average expected contributions of 60.8% while in the intermittent treatment expected contributions are 54.4%. Average expectations are lower in the intermittent feedback treatment than in the round-by-round feedback treatment. However, this difference is not significant using a t-test ($t = 1.014$, $p = 0.323$) or a signrank test ($z = 1.027$, $p = 0.304$).

Figure 2: Expectations and Contributions



Thus, contributions are not motivated by pure altruism.[9] Instead, subjects seek to maximize their own payoff by contributing at a level similar to that of the other

[9] See Croson (1995) for arguments along similar lines.

participants.[10] This result corroborates the earlier findings of Fishbacher, Gächter and Fehr (2001), Keser and van Winden (2000), Burlando and Guala (2004) and Kocher (2004), who find that a majority of subjects in their experiments are *conditional cooperators* – subjects who are willing to contribute more if others in the group do so as well.[11]

We can categorize subjects in our study into different groups depending on subject *i*'s expectations (beliefs) about the contributions of other group members to the public good in round 1 and subject *i*'s actual contribution to the public good in round 1. We will define a subject as a *conditional co-operator* if that subject's contribution to the public account in round 1 falls within one token above or below her stated beliefs about average group contributions in round 1. (Burlando and Guala, 2004 classify subjects as conditional co-operators in the same way). So for instance if a subject expects average contribution of the other group members to the public account to be 6 tokens in round 1, then we will call this subject as a *conditional co-operator* if she contributes 5, 6 or 7 tokens in round 1. Any subject, whose contribution *exceeds the expected average by more than one token*, is a *co-operator* and anyone, whose *contribution falls more than one token below the expected average*, is a *non co-operator*. Thus in our previous example where the subject expects the first round average to be 6 tokens, she would be classified as a co-operator if she contributed 8 tokens or more and she would be regarded as a non co-operator if she contributed 4 tokens or less. Using this metric we get 22 (55%) conditional co-operators, 12 (30%) co-operators and 6 (15%) non co-operators among our 40 subjects.

One point needs to be clarified here. First, conditional co-operators are those whose contributions are positively correlated with their expectations about the contribution of their group member. However it must be borne in mind that this does not necessarily mean that conditional co-operators will always contribute high – they will if they expect others to contribute high but they will contribute low if they expect others to contribute low. There are in fact wide variations in the expectations of the 22

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[10] We believe that the critical role played by expectations may explain why contributions "jump up" when the game is "restarted" as in Andreoni (1988) or Croson (1996). In real life bitterly divided enemies long at war approach the negotiating table with renewed expectations after a cease-fire or long feuding spouses start anew after being separated. It seems that the relatively long inter-trial interval, between the end of the previous game and the start of the new one, is enough to create fresh expectations in the minds of the subjects. They feel that this next time around they will succeed in keeping contributions high and therefore they start with high contributions.

[11] One difference between these studies and ours is that in our study the expectations questions is not payoff-salient. Subjects do not get paid anything extra on the basis of the accuracy or lack thereof of their predictions whereas in most of these previous studies subjects' payoffs do depend on their predictions about the group members' contributions. It appears that the findings about the strong positive correlation between expectations regarding others' contributions and one's own contribution are still valid even when subjects are not paid for their predictions as in this current study.

conditional co-operators in our study ranging from an average expectation of 2 at the minimum (i.e. this subject expects her group members to contribute 2 tokens on average) to 10 at the maximum (this subjects expects everyone else in the group to contribute all 10 tokens). Thus a conditional co-operator who expects others to contribute 10 on average will start with a contribution around 10 herself, while the one who expects others to contribute 2 on average will start at a similarly lower number. To the former subject, however, *the latter will appear to be a non-contributor* and so in the next round the first subject will lower her contribution to the public good. The important point here is that there is no difference in the behavioural propensities of these two subjects. What differs is each subject's "home made" prior beliefs about the behaviour of others – something that we as experimenters have no control over. As Dawes et al. (1977) demonstrate communication among subjects prior to their participation in the experiment (even if that communication has nothing to do with the problem at hand) would be one way to generate more optimistic beliefs and higher contributions among subjects. Orbell et al.(1990) shows that allowing subjects to make non-binding promises to one another also helps especially when such group members make unanimous promises. In a recent study, Chaudhuri, Graziano and Maitra (2004) use an inter-generational framework where one generation of players can leave advice to the next and show that such advice leaving play a crucial role in changing subjects' prior beliefs about the contributions of their group members. In the interests of parsimony we do not pursue this point further here but point the interested reader to the articles cited above.

3.3 Determinants of Contributions in the two treatments

In Table 3 we regress, using a random effects Tobit model, contributions in round t against a set of independent variables that include (1) contributions in rounds $t-1$, $t-2$ and $t-3$, (2) average group contribution in round $t-1$, and (3) round, to pick up the effects of time on contributions. The results are presented separately by treatment. Columns 2 and 3 present the coefficient estimates for the round-by-round feedback treatment while columns 4 and 5 provide the estimates for the intermittent treatment.

Notice from columns 2 and 3 that the crucial explanatory variables behind contributions in round t in the round-by-round treatment are contributions in the previous round, average group contributions in the previous round and finally round. The coefficient for contributions in round $t-2$ is marginally significant (at the 10% level). First, contributions in the previous round are extremely important in determining a subject's contributions in the current round. If the subject contributed more (less) last round then she is likely to contribute more (less) in the current round. Second, the coefficient of average group contributions in the previous round is positive and significantly different from zero. Thus in the round-by-round treatment the average group contributions plays a pivotal role in acting as a reference point on which to base

one's contributions. Each subject uses this as the basis from which to calculate her own contributions. If this average was high in the previous round then she goes with a higher contribution this round whereas if it was low then she goes with a lower contribution. The group average in each round then provides an anchor on which to base one's contribution from round to round. If the group average declines (which it does in the round-by-round treatment) then so will the individual contributions. Finally, the coefficient of round is negative and significant showing that contributions decline over time.

Compare the coefficient estimates in the round-by-round treatment with those for the intermittent treatment in columns 4 and 5. Notice that the important explanatory variables are contributions in rounds *t-1*, *t-2* and *t-3*. The coefficients of average group contributions in the previous round as well as round are not significantly different from zero. Thus we conclude yet again, given that the coefficient of round is not significantly different from zero, that contributions in the intermittent treatment do not decay over time as they do in the intermittent treatment. It is not surprising that average contributions do not play a role because in this treatment subjects do not know the average from one round to the next. However what is important here are the contributions that the subject herself made in the last three rounds. What this suggests is that, lacking any information about how the other members of the group are contributing, the subject now bases her contributions on her own previous contributions. Thus as opposed to the round-by-round treatment where subjects anchored their contributions on the group average, in the intermittent treatment they rely on their own past contributions. In the next section we discuss the implications of these findings and connect our findings to prior research results.

4. Discussion of our results

The most significant insight coming out of this study is that the intermittent feedback treatment subjects do not exhibit the usual pattern of decaying contributions. We believe these subjects engage in less free riding because they focus on a longer horizon and decide for the entire string at once rather than for each round on a case by case basis. This conjecture is reinforced by the fact that in deciding on her own contribution in each round a subject in the round-by-round treatment looked back only to her contribution in the previous round as well as the group average in the previous round. In the intermittent treatment, on the other hand, the subject looked back to her own contributions in the three previous rounds.

Given the strong positive correlation between expectations and contributions, and our other results, we believe that subjects approach the public goods game differently than has been visualized in the past. As we saw the majority of the subjects in our study and in prior studies are conditional co-operators. They come to the game with certain expectations about their fellow group members and start out with

contributions that reflect those expectations. If they expect high contributions from the group members then they respond by contributing themselves. But the round-by-round feedback treatment (which is the usual design of all previous studies), by asking subjects to decide on a trial by trial basis, creates an atmosphere that is more conducive to defection (impulsiveness) via lower contributions, if not outright free riding. Subjects here focus more on winning each trial than focusing on long-term rewards. As subjects defect, others revise their expectations downwards and in turn they defect as well. This lowers the group average which in turn brings forth greater defection in the next period. Thus the round-by-round feedback treatment provides more opportunities for learning the bad lesson that others will free ride and therefore you should too. The intermittent feedback treatment, by forcing subjects to decide on a string of investments at a time, forces them to focus on long-term rewards and hence retards defection and the subsequent decay in contributions.

This brings us to the following reflection on Andreoni's conjecture about learning versus strategies alluded to in the introduction. It seems more plausible to us that it is learning, rather than strategic behavior, which lies at the heart of the decay phenomenon. But the reality behind what the subjects learn is more complex than simply figuring out the dominant strategy of free riding. Subjects contribute high to start with because they expect others to contribute as well and subjects realize that contributing makes everyone better off. That is they perceive the game more as a coordination problem along the lines suggested by Rabin (1998). Thus high contributions are not strategic moves in the sense that a subject, who contributes high, is not trying to lure others (especially those subjects who may be unsophisticated or irrational) into high contributions and then "bail out" and free ride on those high contributions made by others.[12] Rather subjects are genuinely interested in keeping contributions high. What is happening, though, is that over time subjects learn the difficulty of coordinating at high contributions (reaching and sustaining the socially optimal outcome) since some members of the group do free ride, if not all the time, at least occasionally. Moreover even if the subject pool consists of a large number of conditional cooperators who are responding to their beliefs about others' contributions, those beliefs are often widely divergent. Thus, as we saw in Section 3.2, to a conditional cooperator who expects others to contribute high and contributes high herself, another conditional cooperator who contributes low because of different expectations, appears to be a non co-operator. This causes subjects to revise their expectations and start lowering their own contributions. The round-by-round feedback treatment hastens the decay in contributions by making subjects take a more myopic view of "winning" each round.

[12] See our discussion of Andreoni's (1988) arguments about the learning versus strategies hypothesis in the introduction.

A few other remarks are in order before we conclude. Most previous studies of the public goods game report a 40%-60% contribution rate on the first round. In our experiment, the average contribution rate for the round-by-round treatment is 69.5% in round 1 and 45.5% in round 10 while the corresponding figures for the intermittent treatment are 53.5% and 49% respectively. The average levels of contribution in round 1 and especially, in round 10, are much higher than those reported in previous studies.[13] Two facts may have contributed to this. This study was conducted at a small, close-knit, women's college, and the effects of participating in the game with others from the same small community may have caused contributions to increase. Second, the fact that there are only four members in a group might also be a factor. Moreover a combination of the two factors – social closeness of the subjects as well as small group size - may have led to high average levels of investment.

The second curious fact is that round 1 contribution by subjects in the round-by-round feedback treatment are significantly higher than contributions by subjects in the intermittent treatment. We have already found that contributions are closely connected to expectations. Round-by-round feedback subjects expect higher contributions from the group (60.8%) than do intermittent feedback subjects, even though the difference is not significant. This might partly explain the higher initial contributions by the former group. Round-by-round feedback subjects may also have contributed more in round 1 because they were signaling to their fellow group members that they intend to contribute heavily to the public account if others do the same. Round-by-round feedback subjects also know that they will have the opportunity, at the end of each round, of updating their beliefs and making the requisite adjustments to their contributions in case their initial expectations about group members turn out to be incorrect. Since intermittent feedback subjects do not receive feedback on contributions to the public account until round 3, they are not able to signal to the other participants at the beginning of the game. Neither do they have the benefit of updating their beliefs and making adjustments in contribution levels at the end of each round. This might have led to more circumspect behavior on the part of the intermittent feedback subjects resulting in lower initial contributions. As noted above, contributions are not significantly different from round 4 onwards.

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[13] The overall average contribution in our study is roughly 61% in the round-by-round treatment and 52.2% in the intermittent treatment. Compare this to the overall average of 33 2% (16.6 tokens out of 50) in the partners treatment and 41.4% (20.7 tokens out of 50) in the strangers treatment in Andreoni (1988) The weighted average of the two groups in our study is 56 6% while that in Andreoni (1988) is 37.89% In Andreoni (1988) average round 1 contribution 1 is 48.2% for partners and 50.8% for strangers while average round 10 contribution is 11 6% for partners and 24 4% for strangers. In Croson (1996) also, by round 10 contributions have declined to less than 25% in both the partners and strangers treatment.

5. Concluding remarks and directions for further research

This is, admittedly, a preliminary study looking at why contributions decay in a public goods game. We make the conjecture that the problem of decaying contributions in public goods game can be mitigated by forcing subjects to commit to a string of investments rather than have them decide on a case by case basis. In the round-by-round feedback treatment, subjects have more opportunities to observe that their fellow group members are not giving at a consistently high level, and they begin to focus myopically on "winning" the current round instead of thinking about the game as a whole. We find that contributions to the public good are driven by subjects' expectations about their group members. Subjects, who expect others to contribute, themselves contribute to the public good. So in some sense the subjects turn the prisoner's dilemma of the standard public goods game into a coordination game with expectations.

The findings of this study are more in the nature of conjectures rather than definitive conclusions and as such must be interpreted with a degree of caution. The study suffers from a number of limitations which do, however, point the way for future research in the area. We address these questions below.

First, in our study subjects play the stage game for only 10 rounds. In retrospect we should have had them play for a longer period – at least 20 rounds. This would have led to more reliable patterns of behaviour. Second, in our study while both groups of subjects play the game for ten rounds, one group gets ten feedbacks while the other gets three. It is possible that in this game it is not the number of rounds they play that is important – in terms of the learning that occurs – but rather the number of feedbacks. Future work should run replications where subjects play for different durations but receive the same number of feedbacks. One possible approach would be to have four different treatments – A, B, C and D - along the following lines. Groups in treatment A have ten tokens in each round and play for (say) 24 rounds and get feedback at the end of every round - so 24 feedbacks in all. Groups in Treatment B also have ten tokens per round and also play for 24 rounds but get feedback after rounds 4, 8, 12, 16, 20 and 24, thereby getting six feedbacks in all. Groups in a third treatment – Treatment C - play the game for only 6 rounds and get feedback at the end of every round - so 6 feedbacks in all. Groups in Treatment D play the game for 6 rounds as well and get feedback at the end of every round, thus getting 6 feedbacks again. Except in Treatment D each subject will have 40 tokens per round (4 times the per round endowment given to subjects in the other three treatments). These treatments will allow us to look at all possible sources of variation. Treatments A and B differ in the number of feedbacks but the number of rounds are held constant. B and C differ in the number of rounds but the number of feedbacks is held constant. But given that subjects in C play only 6 times while those in B play 24 times the former will end up making less money than the latter. Thus there might be differences in behaviour arising from

this discrepancy in earnings. Treatment D controls for any such income effects by giving subjects four times the endowment compared to subjects in treatment B. Thus we can compare treatments B with D which have the same number of feedback and comparable levels of endowment.

While we do not suggest that we have explained why contributions decay over time in public goods games, we think we have taken a step towards better understanding the dynamics of contributions in such games, one that will hopefully stimulate further research in the area.

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Table 1: Average Contributions in the Two Treatments by Round

Round	Avg. Contributions : Round-by-round Feedback	Std. Deviation: Round-by-round Feedback	Average Contributions: Intermittent Feedback	Std. Deviation: Intermittent Feedback
1	6.95	2 67	5.35	2.60
2	6.85	2.94	5.5	2.80
3	6.95	2 95	5.2	2.73
4	7 15	2.76	6.15	1.87
5	6.75	3.08	5	3.08
6	5.85	3.47	5.3	3.15
7	5.9	2.61	5	3.13
8	5.05	2.93	4.85	3.13
9	4.95	2.74	4.95	3.46
10	4.55	3.58	4.9	3.42
All	6.095	2.973	5 22	2.937

Table 2: Testing for Differences in the slopes.
Dependent Variable = Average Contributions

Variable	Coefficient	Std. Error	Z	p-value
Round	-0.643***	0.15	-4.38	0.000
Group	-2.65***	0.73	-3.6	0.000
Group*Round	0.263***	0.09	2.85	0.004
Constant	11.62***	1.21	9.55	0.000
LR χ^2	41.25***			0.000

***: Significant at 1%

Table 3: Random Effects Tobit Estimates

Dependent Variable: Contributions in period *t*

	Round-by-round Feedback Treatment		Intermittent Feedback Treatment	
	Coefficient	Standard Error	Coefficient	Standard Error
Contributions in round *t-1*	0.621*** (4.96)	0.125	0.436*** (3.58)	0.122
Contributions in round *t-2*	0.104 (0.75)	0.138	0.225** (1.95)	0.115
Contributions in round *t-3*	0.221* (1.77)	0.125	0.338*** (2.9)	0.116
Average group contributions in round *t-1*	0.471*** (2.84)	0.166	0.185 (1.00)	0.184
Round	-0.341*** (-2.53)	0.135	-0.12 (-1.01)	0.119
Constant	-0.608 (-0.41)	1.489	-0.351 (-0.25)	1.399
LR χ^2	104.15***		57.16***	
Pseudo R^2	0.144		0.141	
Number of Observations	124		130	
Number Uncensored	93		102	
Number Left Censored	11		17	
Number Right Censored	20		11	

z-statistics in parentheses

***: Significant at 1%
**: Significant at 5%
*: Significant at 10%

Appendix

Instructions For the Intermittent Treatment

Player ID #

This is an experiment in the economics of behavioural decision-making. Wellesley College has provided funding in order to conduct this research.

The instructions are simple. If you follow them closely and make appropriate decisions, you may make an appreciable amount of points. The accumulated points will be exchanged for cash at the end of the experiment.

The experiment will consist of a number of periods. You will be in a market with 3 other people.

In every period you have an endowment of 10 tokens. **Each token is worth a point.** In each period you will have to decide between investing your tokens in a **private account** or a **public account**. Tokens invested in your private account are worth exactly 1 point each. However, tokens invested in the public account work in the following way. In every period the total tokens invested in the public account will be added. The sum is then doubled and then the resulting amount equally distributed among the group members. Thus the points you can earn from the public account depend on what you and every other participant contributes.

Suppose in period 1, you decide to invest 5 of your 10 tokens in your private account and contribute the remaining 5 tokens to the public account. Suppose in that particular period, the total number of tokens contributed to the public account is 20. This number would be doubled (to 40) and distributed back to each participant. This means that each member gets back 10 tokens which are then worth 10 points (1point each). Then your earnings from this experiment will be 5 points from the 5 tokens that you invested in the private account + 10 points from the public account = 15 points.

You could potentially get a return from the public account even if you do not contribute any tokens to the public account as long as other participants contribute.

Every period will work in the following way. At the beginning of the period each participant will decide how many tokens to invest in the private account and how many to invest in the public account. Each participant will then inform the experimenter about the number of tokens she wants to invest in the public account, by writing this number on a small piece of paper. The experimenter will add up all the tokens contributed to the public account, double that and redistribute them equally among all participants. Each participant will then note down her total earnings for the period on the Record Sheet. The period then ends and the next one begins. Please turn to the next page titled Record Sheet to see how you will keep track of your earnings.

Feedback on contributions to the public account will be given at the ends of period 3, 6 and 10.

At the end of the experiment your total point will be converted into cash at the rate of 1 point = US $0.05. You will be required at the end to complete a simple receipt requesting information such as you name, student ID number, dorm name, total amount of funds earned and signature.

If you have any questions, please ask them now.

Questionnaire #1

How many people do you think will contribute each of the following numbers of tokens in round one?

0 _____

1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

7 _____

8 _____

9 _____

10 _____

Record Sheet

Period	Tokens in Private Account	Tokens in Public Account	Total Earnings from Public Account	Total Earnings (Add Columns 2 and 4)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
			Total	

Arthaniti 3 (1-2), 107-111 / 2004

A Comment on Avoidance of Odd-eighth quotes on Nasdaq*

Diganta Mukherjee**

Abstract

Barclay (1997) has examined the avoidance of odd-eighth quotes on Nasdaq and tried to give an explanation for this phenomenon in terms of strategic behaviour by market makers. But, in the empirical analyses, we noticed a few statistical problems in his use of the t-test and linear regression. In the light of these problems, his results seem to be based on a shaky foundation.

JEL Classification : G18.

Keywords : Odd-eighth quotes, t-test, regression.

Before automation, the stock prices in the American stock exchanges like the New York Stock Exchange (NYSE), Nasdaq or the American Exchange (Amex) were quoted in multiples of $1/8^{th}$ of a dollar. Thus, the smallest increment (tick size) was \$1/8. The bid ask spread (difference between the bid price and the ask price), consequently, was also 0 or a multiple of \$1/8. **Barclay (1997)** addresses the very interesting issue of the avoidance of odd-eighth quotes (1/8, 3/8, 5/8 or 7/8) on Nasdaq and its possible explanations. It has been noted extensively that market makers avoid odd-eighth quotes for many securities listed in Nasdaq and hence increase their effective tick size. It has also been noticed that bid-ask spreads are larger when this avoidance takes place (**Christie and Schultz, 1994** and **Christie et. al., 1994**). Many authors have tried to give explanations of this phenomenon and its use as a coordination device among market makers for maintaining supra-competitive bid-ask spreads. Another view is that the high cost of making the market for Nasdaq securities is reflected by these high spreads (**Grossman et. al., 1995** and **Kleidon and Willig, 1995**).

Barclay examines 472 securities, which were moved to NYSE/Amex from Nasdaq between 1983 and 1992. He finds that when Nasdaq market makers systematically avoid odd-eighth quotes, bid-ask spreads are large and they decline *dramatically* after the switch from Nasdaq to NYSE/Amex. Whereas, when the market makers use both even and odd eighth quotes, spreads are smaller and decline only slightly with exchange listing. This difference in spreads cannot be explained by security specific

* I am grateful to Prof. Sugata Marjit for his encouragement in writing this comment. The general disclaimer applies.

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characteristics. He goes on to conclude, based on his empirical exercise, that the avoidance of odd-eighth quotes is indeed used as a coordination device among Nasdaq market makers to maintain supra-competitive prices.

While looking at the tables showing the empirical findings of this paper I came across a few problems which I would like to communicate.

In Table 1 (pp. 43, reproduced here), Barclay is testing for differences between the two quoted/effective half spreads pertaining to the 'Before NYSE/Amex listing' group and the 'After NYSE/Amex listing' group, in $/% terms, y_1 and y_2 say. Here, the author is probably using a paired t-test (the paper does not specify the exact testing procedure) on $\overline{y_1}$ and $\overline{y_2}$ using a pooled sample variance averaging the group sample variances s_1^2 and s_2^2 (say). But, for this test to be valid, one must test for the equality of the population variances σ_1^2 and σ_2^2 first. This test is, unfortunately, rejected in all cases. For example, for quoted half-spread (= (ask – bid)/2, in $) for 'all securities', the ratio of the two sample variances is roughly 44.44, which is significant for the corresponding F-test at .001 level. Due to this phenomenon, none of the paired t-tests are valid in this exercise. So the conclusions hence drawn are void. This can be verified by using the distribution free *Chebysheff Inequality*, which also contradicts **Barclay**'s conclusions. Also, if one standardizes the quoted/effective half spreads (in $) by dividing the mean by its standard deviation (popularly known as z-transformation, $\bar{x}/s$), for 'all securities' and 'even quotes', it will be lower for the 'Before NYSE/Amex listing' group than for the 'After NYSE/Amex listing' group. For example, for effective half-spreads (= transaction price – (ask + bid)/2, in $) for 'even quotes', the standardized value for the 'Before NYSE/Amex listing' group is roughly 24.16 while the corresponding value for the 'After NYSE/Amex listing' group is 54.11. This also goes strongly against the conclusions of this paper.

The reason that the regression results, reported in Table 2 (pp. 49, reproduced here), are significant is again due to a mis-specification in the regression model. The model used here is

$$\Delta y = \alpha + \beta \Delta x + \varepsilon$$

in the OLS setup (Δx = change in even-eighth quotes and Δy = change in half-spread). But Δx is eminently stochastic in this model and the variance of the error term has to incorporate this fact. Also, as y_1 and y_2 have significantly different variances, the error component of the model must be modified accordingly. Hence the author underestimated the error variance component twice and this might have caused his $\overline{R}^2$'s, reported in Table 2, to become significant (ranging between 0.11 and 0.25), whereas, in reality, this may not be the case.

Having noted these problems, one is tempted to conclude that the conclusions of this paper, which are very interesting indeed, are based on a shaky foundation. Hopefully future research will help clarify this situation.

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Table 1

Summary statistics for 472 securities that were traded on Nasdaq and moved to the NYSE or Amex between 1983 and 1992. The subsample identified as 'all even quotes' had more that 90% of their closing bid and ask quotations on even eighths during the 60 days prior to listing on the NYSE or Amex. Daily trading volume is measured in thousands of dollars, market capitalization is measured in millions of dollars. For each variable, the table reports the mean, median [in square brackets] and standard deviation (in parentheses)

	All securities		All even quotes		Odd and even quotes	
	Before NYSE/ Amex listing	After NYSE/ Amex listing	Before NYSE/ Amex listing	After NYSE/ Amex listing	Before NYSE/ Amex listing	After NYSE/ Amex listing
Quoted half-spread (S)	0 23 [0.19] (0.2)	0.13 [0.12] (0 03)	0 33 [0.26] (0 23)	0.14 [0.13] (0.03)	0.13 [0.11] (0.06)	0.12 [0.11] (0.03)
Effective half-spread (S)	0.18 [0.15] (0.14)	0.07 [0.06] (0.02)	0.25 [0.21] (0.16)	0.07 [0.07] (0.02)	0.11 [0 09] (0.05)	0.07 [0.06] (0.02)
Quoted half-spread (%)	1.86 [1.29] (1.89)	1.04 [0.87] (0.73)	2.23 [1.52] (2.19)	0.88 [0.75] (0.47)	1.48 [1.02] (1.42)	1.22 [1.00] (0.89)
Effective half-spread (%)	1.5 [1.03] (1.45)	0.56 [0 45] (0.42)	1.74 [1.20] (1.62)	0.44 [0.38] (0.24)	1.25 [0.88] (1.19)	0.68 [0.56] (0.52)
Even-eighth quotes(%)	78 [91] (24)	55 [54] (7)	99 [100] (2)	56 [55] (7)	56 [53] (15)	54 [53] (6)
Price per share ($)	17.77 [15.01] (12.61)	17.51 [14.82] (12.18)	21.45 [18 19] (13.22)	20 48 [17.77] (12 33)	13.99 [11.17] (10.6)	17.47 [10.77] (11.26)
Number of market makers	12.92 [11] (8.63)	1 --- ---	10.27 [9] (6.64)	1 --- ---	15.64 [14] (9.05)	1 --- ---
Daily trading Volume	1878 [463] (4916)	977 [255] (2258)	1847 [361] (4870)	989 [192] (2326)	1911 [5901] (4974)	966 [297] (2191)
Number of Securities	472	472	239	239	233	233

Table 2

Regressions of the change in bid-ask half-spreads when securities move from Nasdaq to the NYSE or Amex on a constant, the change in the frequency of even-eighth quotes, the change in the average price inverse, the change in the daily stock return standard deviation, the log Nasdaq trading volume, the log NYSE or Amex trading volume, and the log number of Nasdaq market makers. Sample: 468 securities that moved from Nasdaq to the NYSE or Amex between 1983 and 1992. Changes are calculated as the Nasdaq value minus the NYSE or Amex value for each security. (*t*-statistics in parentheses).

Dependent Variable	Intercept	Change in even-eighth quotes	Change in Price inverse	Change in Return std. dev.	Log Nasdaq volume ($)	Log NYSE/ Amex volume ($)	Log number of market makers	Adjusted R^2
Quoted Half-spread ($)	0.01 (1.28)	0.39 (11.88)						0.23
Effective Half-spread ($)	0.05 (5.68)	0.30 (12.39)						0.25
QuotedHalf-spread (%)	0.19 (1.88)	2.74 (9.09)						0.15
EffectiveHalf-spread (%)	0.50 (6.11)	1.90 (7.67)						0.11
QuotedHalf-spread ($)	0.26 (6.02)	0.15 (4.96)	-0.55 (-4.03)	2.81 (6.26)	-0.03 (-3.54)	0.05 (4.82)	-0.15 (-9.72)	0.52
EffectiveHalf-spread ($)	0.25 (7.84)	0.12 (5.51)	-0.41 (-4.15)	2.16 (6.58)	-0.02 (-2.46)	0.03 (3.54)	-0.11 (-9.94)	0.54
QuotedHalf-spread (%)	4.08 (15.22)	0.54 (2.90)	2.44 (2.90)	29.61 (10.67)	-0.38 (-6.55)	0.18 (3.01)	-0.39 (-4.15)	0.63
EffectiveHalf-spread (%)	3.48 (10.06)	1.02 (4.23)	4.63 (4.27)	33.91 (9.46)	-0.46 (-6.19)	0.36 (4.64)	-0.71 (-5.76)	0.60

BOOK REVIEW

Rotting From The Head
Salim Rashid (ed), 2004
The University Press Limited
Dhaka, Bangladesh
Tk. 550.00

Rotting From The Head edited by Salim Rashid (2004) invites comparison with a rather slim volume by J.K.Galbraith entitled The Economics Of Innocent Fraud (2004). In the latter, Galbraith has taken up a seeming and severe contradiction relating to fraud and innocence. In both private life and public discourse one does encounter innocent lawful fraud. Unfortunately, this is hardly recognized. So the net effect is that it fails to produce any sense of guilt or responsibility.

In order to be able to categorize Rotting From The Head as belonging to a particular genre of literature, it would perhaps be appropriate to deal at some length on the ideas that have been thrown up by Galbraith's short but interesting treatise. This would prepare the reader for the collection of articles that has been put together by Rashid.

It is Galbraith's contention that some of this fraud derives from traditional economics and its teachings some originate from the ritual views of economic life. Such fraud can strongly support individual and group interests, particularly that of the more fortunate, articulate and politically prominent in the larger community. While fraud can achieve the respectability and authority of everyday knowledge, it may be the contrivance of any individual or group. It may represent the natural, even righteous view of what best serves personal or larger interest. For instance, what economists read, learn and teach is well motivated no doubt. But, there is always popular error. So compelling is the current fashion and pecuniary interest, that even the everyday characterization of the economic system tends to be affected. And, in keeping with these interests and pressures of fashion, the larger economic and political systems tend to cultivate their own version of truth.

The implication of such a contention is the inevitable divergence between approved belief (or conventional wisdom) and reality. Reality appears to be more obscured by social or habitual preference and personal or group pecuniary advantage, in economics and politics to greater extent than in any other discipline. This is despite the point that in the end, it is reality that counts and in Galbraith's opinion, we have given ourselves over to self-serving beliefs and "contrived nonsense" or simply fraud. To make his point clear he takes up a concrete example from the modem industrial society, drawing attention to the passage of power from the modem corporate owners, that is the shareholders, to the management board. Managerial authority and theft

may be accompanied by co-operative and corrupt accounting practices. Such fraudulence comes at the expense of the economy, effective government and the business world. One observes the strong linkage between the power of management within the corporate sector and that of the government. On account of its self-interest, such power extends beyond the private domain and encroaches the public domain, where political compulsions make the exercise of power less effective. The perspectives relating to the unprecedented control on the part of the private sector over the public sector, is not new, no doubt. Anyone familiar with the political economy of Indian development planning experience will recognize such linkages.

Rotting From The Head may be said to belong to that class of literature where the theme of the divergence between approved belief or conventional wisdom and reality finds focus in the context of the issue of corruption in the public sphere. Similar to the enlarged power of the private sector and its penetration and extension into the public domain, Rashid draws attention to the power of a relatively new group of players in the international arena. It is the cartel of aid donors that require to be taken into account. For, their extensive powers over the client countries have been found to produce negative influences on the efficiency and effectiveness of governance. To put it briefly, there may be reasons to relate the crises in government accountability in the developing world to the corrupting influences of aid agencies, to some extent.

This brings to mind the inherent paradoxes relating to the globalization process that Stiglitz (2004) had discussed in his book Globalization And Its Discontents. Such contradictions include among others the stress on global governance by the global institutions and complete silence on their part on the absence of any composite global government The spotlight on transparency and accountability of the aid recipient governments and the total darkness and disregard of the propriety of their own actions and policies on the part of these international public institutions are indeed paradoxical positions. Like Stiglitz, Rashid has tried to capture such paradoxical situations through a scrutiny of the public dishonesty and deterioration in the quality of governance in much of the aid receiving countries, particularly in the context of such distortions in donor behaviour, that have been identified by the former chief economist of the World Bank.

The book under review thus tries to test the hypothesis relating to donor-induced corruption in LDCs. The main actors are the I.M.F, the World Bank and etc. It is the reach and influence of these actors which are sought to be examined with reference to primary documents that have been submitted and used in Judicial proceedings in the Bangladesh High Court in three cases involving the UNDP and the World Bank. These three cases (two if taken in lot) in the opinion of the author, provide the first evidence on the detrimental impact of international aid on governance and growth. The points emerging from these cases are sought to be located in the literature on donor agencies

and corruption that McNab & Melese review in this volume. Their review provides the theoretical underpinnings to the subject. Some recent empirical backup is provided by the studies of some donor agencies, by Evrensel and also by Berrios that have been included. The article by McNab & Everhart deals with the overall performance of aid.

Against such background, the detailed documentary evidences from Bangladesh that have been painstakingly included in the book by M.U.Rashid, scholar and ex-civil servant are used to build up the arguments relating to the role of multilateral aid agencies in engendering corruption. The relevance of the collection of articles perhaps may be said to lie in the conclusion that fundamental changes in donor behaviour are imperative to the realization of the full potential of the globalization process. On the whole, what Rotting From The Head tries to test, is the hypothesis that international aid, while it may increase the level of corruption, may at the same time, lower the quality of governance. The appropriateness of such a hypothesis perhaps arises from the positive relationship between the quality of governance and growth, that make one alert to the negative or potential distortionary impact of international aid and policy advice on government/governance failure and hence on growth.

The extensive coverage of the three cases has the objective of laying bare the link between aid and domestic politics from a particular country's (namely Bangladesh) point of view. The intricacies of the patron-client mechanisms operating within the global context are brought out in this book. The implications of such mechanisms on the effectiveness or ineffectiveness of aid enriches the set of country-specific experiences that may be useful to development practitioners. The imbalance of power between the international institutions and the "client" countries has been sought to be established by focusing on the nature of UNDP's bureaucracy and its management policy or the World Bank's claim to immunity from all prosecution in the event of any legal suit by any of its employees in a country in which it has office. And the examples are drawn up from Bangladesh.

In the concluding part of the book, the possibilities of any independent watchdog in the international sphere, that may help check such asymmetry of power among nations are explored. Reference is made to the experience with Transparency International (TI), its local arm the Transparency International Bangladesh (TIB) and its computation of the Corruption Perception Index (CPI) for Bangladesh. Given Bangladesh's low rank, Rashid would have been pleased had such a watchdog checked upon the donors too. As to the limitations of using the CPI as an indicator of the extent of corruption, he has discussed the usual reasons.

Without going into such details, it may be useful to see how this book differs from the many other studies on corruption. By taking up a country's case the editor of this volume tries to balance the theoretical and empirical sides to the corruption problem. While many studies seem to lack an analytical framework, this book selects

the independence of bureaucracies to be the sheet anchor of corruption. The relevant propositions that guide the logical structure of the model are as follows. Under hierarchical social arrangements and bureaucratic set up, if the top rots, the bottom must follow suit. Hence the title Rotting From The Head. Aid produces such rotting, making the domestic bureaucracies 'porous' and amenable to outside influence. No wonder one may find the weak administration of rules and laws. The effects of compromised bureaucracies spill over into other parts of the civil society namely the NGOs and the Press. Such effects may extend to expatriate newsgroups in the West and to other international organizations that may be devoted to the cause of good governance. The muted response to possible malfeasance of the donors by these components of the civil society may be explained in terms of the immense power and influence, which the donors wield. According to Rashid, it is the self-interest motive of civil society that may lead to its acquiescence to such informal colonialism.

Committed to the cause of underdevelopment in general and the welfare of Bangladesh in particular, the author's frustration and disappointment with the corroding influence of the nontransparent donors on the institutional building and good governance efforts of that country, is amply borne out by this collection. The apparent paradox between their insistence on accountability and transparency in LDC governments' finances and management and their own often-active complicity in fuelling corruption is brought to the attention of the readers. By working with the hypothesis of donor culpability, the objective of the essays is to relate malgovernance in the developing world to the institution-weakening proclivities of the international financial agencies. The mechanisms of aid dependency have been touched upon here. The more important contribution of the book is the perspective that the source of corruption may be, to a large extent, the donor agencies themselves. The architecture of international financial institutions may explain much of it. This may appear to be a rather strong statement but Rashid leaves no stone unturned to establish such a point. The benevolence of aid as he would like to argue is "contrived nonsense" or simply fraud in Galbraith's sense of the term that has been referred to in the introductory part of this review.

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